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Table of Contents

NEWS DEVELOPMENTS

Navy Endorses Higher Rate of Production at Elk Hills 42
Deferment Regulations Eased 42
PAO-5 and Directive 59 Scored at Hearing 42
Mississippi Urged to Adopt Adequate Conservation Legislation 43
Majors Blamed for Creating Oil Shortage 44
Hungary Rising Rapidly as Petroleum Producer 44
Reservoir Control and Behavior Discussed at A.I.M.E. Meeting 46
Bureaus Vie for Authority in Probing Natural-Gas Industry .. 47
World Court Judge Blasts Petroleum Reserves Policy 48
Gas Men Agree on Programs 50
A.G.A. Abstracts (Natural-Gas Conference) 53

Trends 41
This Week 45
Editorial 49
Deaths 54
Refining News 95
Pipe-Line News 99

ENGINEERING AND OPERATING

Increased Oil Recovery by Gas Injection from Old Sands 57
The Basic Gas-Turbine Plant and Some of Its Variants 59
Rotation-Type Gas-Lift System 67
Transmission-Line Experience in Appalachian Region 69
Compressor-Station Design for Long-Distance Transmission .. 71
A.G.A. Abstracts—Natural-Gas Conference 76
A.I.M.E. Abstracts—Petroleum Division Meeting 79
Greater Depths, Hard Formations Increase Ordovician Costs . 81

Books 68
Plant Practices 84
Front Lines in Refining .. 86
Cost Engineering 89
Eng. Fundamentals 91
Questions on Technology 93

EXPLORATION AND DRILLING

Week's Highlights 103
Completions in All Fields 103
Daily Average Production for Week 104
Reports by Areas Start on Page 104
Wildcat Completions and Discoveries 115

ADDITIONAL FEATURES

Drilling Contractors 116
Market Summary 117
Crude Prices 117
Personals 118
Progress in Equipment 121
Classified Advertising 122
Calendar of Events 124
Index to Advertisers 124

Hycar Gate Packer made by Murray Rubber Company for Cameron Flex Seal Mud Line Valves. Cutaway of valve is shown in inset.

Photographs courtesy Cameron Iron Works, Houston, Texas

USE HYCAR WHERE THE GOING GETS TOUGH

TAKE it from a "roughneck", the going gets tough in a mud line valve in oil well drilling operations. Drilling fluid contains gas, oil—often acids. And drilling mud, moving at high velocity, quickly cuts the metal-to-metal seal usually found in ordinary valves.

Engineers of the Cameron Iron Works wanted to lick this problem because it was costing extra time and expense. Conventional valves had to be removed and sent to a shop for repairs.

After exhaustive tests, Hycar synthetic rubber proved by far the best available material for this tough service. Now Cameron Flex Seal Mud Line Valves not only give longer service, but when the Hycar gate packer is finally worn out, it can be replaced quickly and easily right in the field at one-third the cost of repairing conventional valves.

Here is just another example of how Hycar—with its superb resistance to petroleum products, its high abrasion resistance and its high tensile strength can keep going where the going gets tough.

Ask your supplier to furnish you parts made of Hycar for actual tests in your own applications. Find out for yourself just what Hycar can do to reduce operating costs. *Hycar Chemical Company, Akron 8, Ohio.*

What Hycar Does in Cameron Mud Line Valve

1. Resists action of abrasive-laden fluid under high pressure and moving at high velocity.
2. Resists oil, gas and acids that are usually present in drilling fluids.
3. Slow rate of wear—even under worst conditions.
4. Makes a positive, leak-proof seal, even after a long period of service, or after gate is sand-cut or damaged.
5. May be replaced in the field in a few minutes—and at little cost.
6. Performance proven by exhaustive tests—both in the laboratory and under field conditions.

Hycar

Reg. U. S. Pat. Off.

LARGEST PRIVATE PRODUCER OF BUTADIENE TYPE

Synthetic Rubber

the OIL AND GAS JOURNAL

Trends

Crude-Oil Production By States—Page 104

CRUDE-OIL STOCKS 234,166,000 bbl. as of May 6—down 1,176,000 bbl. One year ago 241,856,000 bbl.

GASOLINE STOCKS 88,267,000 bbl. as of May 6—down 195,000. One year ago 87,970,000 bbl.

RESIDUAL FUEL-OIL STOCKS 49,841,000 bbl. as of May 6—down 144,000. One year ago 67,659,000 bbl.

GAS OIL AND DISTILLATE STOCKS 30,438,000 as of May 6—up 202,000. One year ago 30,854,000 bbl.

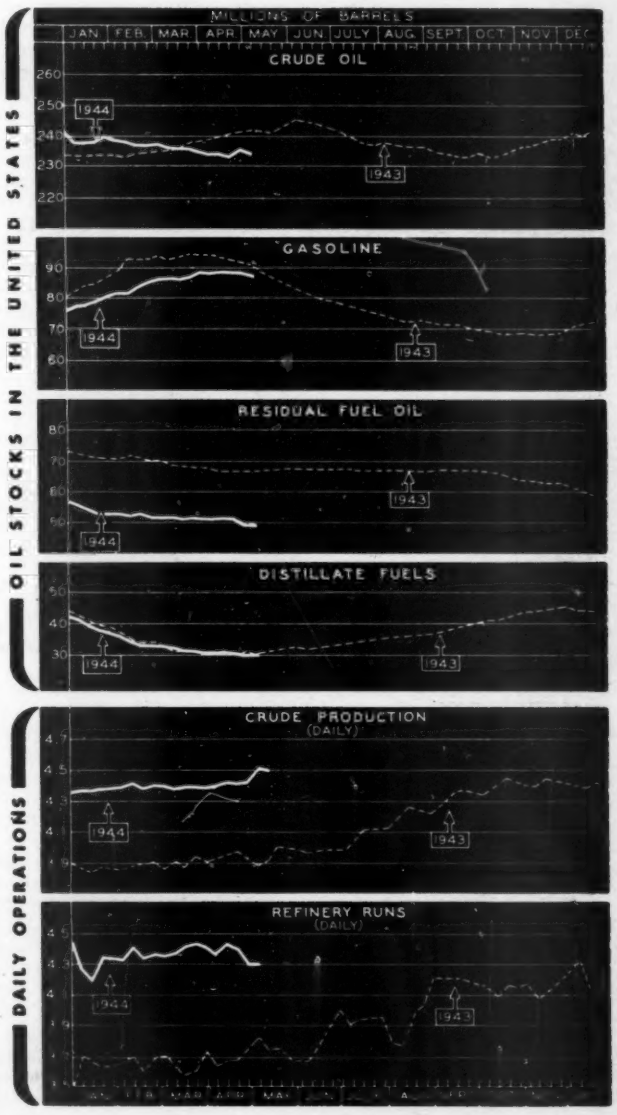
CRUDE-OIL PRODUCTION 4,511,600 bbl. daily average week ended May 13—down 17,250 bbl. Year ago 4,013,985 bbl.

REFINERY RUNS 4,316,000 bbl. daily week ended May 6—up 16,000 bbl. Year ago 3,744,000 bbl.

AMONG a large segment of producers and among purchasers and refiners, discussions continue to center in the details of the proposed subsidies for stripper-well operations. It had been expected that the plan would be definitely announced before the middle of May and delay has raised the question of whether or not a program different from that under consideration a month ago is in the making. So far as the petroleum industry is concerned it is apparent that there will be no further opposition to the plan, at least until the details are announced. The industry through the Petroleum Industry War Council and through other organizations is on record in opposition to the principle of subsidies in production operations and its position that general price advances are required in the present operating situation is well established.

NUMEROUS questions are arising as buyers of stripper-well output, ranging from the small refiner who gets crude from fields adjacent to his plant to the major buyers operating in several states, attempt to apply available provisions of the subsidy plan to their operations. The program, as it has been outlined to the industry so far, is broad in scope with the field the unit of application. There are those who contend that the inequities in this type of application are so fundamental that some program which takes into consideration production conditions on individual leases or by wells will have to be worked out.

IT is also contended that in some situations it will be impossible to ignore the varying cost factors, such as the total liquid production and the depth of wells. Surveys show that in some instances several producers would receive little more for their oil than they do now while others in the same field would be on a substantially better basis. Questions also are arising as to the position of royalty owners and leasing arrangements which are not identical as to terms. There is conjecture concerning collection of taxes, which vary by states. Agreements in which the producer is guaranteed the highest prices paid in a given area are a subject of doubt. These and other matters have brought unanimous agreement among buyers that they will not be responsible for application of the plan, which is certain to arouse many controversies. That "chore," they say, properly belongs with the government agency which will administer it.



Navy Endorses Higher Rate of Production at Elk Hills

by Henry D. Ralph

WASHINGTON. — An increase of 50,000 bbl. a day in crude production from the Elk Hills reserve was recommended this week by the Navy, at the request of the joint chiefs of staff, to bring total production to 65,000 bbl. daily or 30,000,000 bbl. by the end of 1945. The increase, Navy Secretary Forrestal told the House naval affairs committee, is considered imperative to meet demands.

Such a project would take about 10 months to reach production peak, it is understood here.

Urging immediate congressional action to authorize increased production in Naval Petroleum Reserve 1 (Elk Hills), Navy Under Secretary Bard asked for quick passage of H.R. 4771 to legalize the pending Navy-Standard Oil Co. of California unit-plan contract for operating the reserve, passage of a compromise measure, or a simple congressional joint resolution authorizing the increase pending final legislation on the entire Elk Hills problem.

Chairman Vinson opened the hearings with objections to the Navy bill, which he introduced at Navy's request last week, and announced that he would offer a substitute bill for committee consideration this week. His major objection to the present bill, Vinson said, is that it would remove control of naval petroleum reserves from Congress and place it in the hands of the executive branch. His substitute gives Navy control over reserves, subject to congressional approval.

Additional witnesses scheduled include Navy representatives; Floyd S. Bryant, Standard of California vice president, and representatives of Kern County, California.

Strong support for more production from Elk Hills came from Petroleum Administrator Ickes, the Army-Navy Petroleum Board and the Joint Chiefs of Staff, all of whom have recommended that the Navy use more oil from its Petroleum Reserve 1. At the present time, the Navy and Standard of California are producing 15,000 bbl. a day.

The Navy, it was learned here this week, has reversed its position on Elk Hills production and the department is believed now to favor increases to help fill West Coast war demands for petroleum.

The question of condemnation of the privately owned lands, favored by several congressmen including Vinson, is expected to come up again. The Navy has repeatedly expressed its stand against condemnation. The contract in question, Navy points out, will give the Navy complete control over the field, making condemnation unnecessary.

Witnesses scheduled to appear before the House committee will probably include Rear Adm. H. A. Stuart, director of Navy Petroleum Reserves.

Deferment Regulations Eased

WASHINGTON. — Draft deferment for essential men over 26 in the oil industry should be much easier as a result of new regulations issued last week by the Selective Service System, in the opinion of manpower experts of the Petroleum Administration for War.

The new regulations are now being studied, and a memorandum on their application to petroleum operations will be issued shortly for the guidance of the industry.

Definitions of necessary men and essential activities remain roughly the same, with determination of occupational deferment requests made by local draft boards and state selective service directors, and requests for deferment of men over 26 will not be cleared through the Washington office of PAW as was done in the case of men under 26. Marketing and distribution activities in the oil industry are still not eligible for occupational deferments.

The prospect is that most men over 30 engaged in essential activities in petroleum production, refining and transportation will be deferred indefinitely, while deferments for men between 26 and 30 will be made much easier and such men probably will not be called for review of their deferments for at least 6 months.

PAW has just been given authority to review occupational-deferment requests for men under 26 engaged in key technical activities in the production of aviation and special military lubricants, and employers are invited to submit requests on Form 42-A Special.

The work of clearing deferment requests for men under 26 engaged in production and 100-octane refining is virtually ended, and only an occasional request is now being received. From the production and exploration branch of the industry, PAW received 622 requests and certified 192 for deferment, denying 430. In refining 100-octane gasoline and components for synthetic rubber there were 1,776 applications of which 1,383 were certified for deferment and the remainder of 393 either failed to meet the requirements or are still under review. In addition there were 100 requests for U. S. citizens engaged in various petroleum operations abroad, of which 89 were certified for deferment and 11 were denied.

PAO-5 and Directive 59 Scored at Hearing

WASHINGTON.—A demand for repeal of Petroleum Administrative Order 5 and Petroleum Directive 59 issued by Petroleum Administration for War was made before the House petroleum subcommittee May 15 by spokesmen for independent jobbers in District 1.

The attack was opened by Rep. Mendell Rivers of South Carolina, who urged the committee to approve the bill, H.R. 3819, which he introduced last December to rescind PAO-5 and Directive 59. Other witnesses were John D. Meyer, secretary of the Eastern Petroleum Importers Conference, and R. W. Jones, president of the Georgia Independent Oil Men's Association and director of the Southeastern Oil Jobbers Conference.

Rivers said the two PAW orders legalize a domestic cartel which existed before the war whereby major oil companies divided up marketing territories, operate to the advantage of big distributors, and are intimidating, discouraging and destroying independent jobbers in District 1.

In a lengthy explanation of the history and operation of Directive 59, Meyer said it was drafted by a committee of majors at request of PAW to provide pooling of facilities and supplies to cope with the transportation shortage in 1942, and that while some independents were later added to the committees they are powerless to prevent the plan from operating to their disadvantage. Since Directive 59 was only a recommendation for voluntary action, he said PAW issued PAO-5 to give it the force of law, with the result that no independent can obtain products from a primary supplier unless he agrees to partici-

pate in Directive 59. Meyer charged unequivocally that PAW is an agent of the majors in a scheme to prevent independent jobbers from obtaining adequate supplies, and he declared that total supplies in District 1 would have been larger had Directive 59 not been in force.

Committee members declared this was a serious charge and pressed Meyer for details but he refused to give specific instances except in executive session because he said PAW would make deals with complaining jobbers to keep them quiet.

Meyer advocated a single allocation system based on the flowback of OPA ration coupons and elimination of the PAW allocation system, declaring this works to the advantage of all, including independent jobbers, in 31 states outside of District 1, and that no other rationed commodity is subject to a dual allocation system.

Deputy Petroleum Administrator Ralph K. Davies and other PAW officials were scheduled to appear before the subcommittee later this week for a general discussion of supply and distribution problems. They planned to make a report on the 100-octane program and improvements in transportation and stocks, but the committee undoubtedly will call for an explanation of the District 1 allocation system and charges that it reduces supplies and discriminates against independents.

Early Action Anticipated on Stripper Subsidy Proposal

WASHINGTON. — Early action is anticipated by the Office of Economic Stabilization on the proposal to subsidize a premium price for crude oil produced from stripper wells.

OES is currently awaiting a report from the Petroleum Administration for War, now that the Petroleum Industry War Council has referred it back to PAW with an ambiguous resolution. Although an adverse report by PAW would not be unexpected, OES plans to take steps to put the subsidy plan into effect as soon as possible. It is felt that no additional legislation or appropriation would be required, since subsidiaries of Reconstruction Finance Corp. have authority and funds to subsidize production of war materials.

Oil State Solons Push Demand for Increase

WASHINGTON. — A further demand that Congress require an increase in the ceiling prices of crude petroleum through an amendment to the pending legislation to continue the price stabilization law was made before the House committee on banking and currency last week by a group of oil-state congressmen headed by Representative Wesley Disney of Oklahoma.

Earlier, representatives of oil producers had made the same plea to both House and Senate committees now holding hearings on the bill. Disney asked for a crude-price formula based on parity with the wholesale commodity price index, similar to the provisions of his bill which passed the House last December. Members of the committee showed a disinclination to include any amendments on specific commodities, suggesting that ample opportunity will be given for offering such amendments on the floor of the House when the bill is up for debate.

Mississippi Urged to Adopt Adequate Petroleum-Conservation Legislation

BILOXI, Miss. — Mississippi was urged here this week to take full advantage of its bright petroleum-production potentialities by enacting adequate conservation laws designed to yield the maximum recovery from its newly discovered reservoirs and those remaining to be found.

The benefits accruing to the state, the industry, and individual operating units functioning under adequate laws for enforcement of optimum rates of crude-oil withdrawals were outlined before the Mississippi Bankers Association here May 16 by Joseph E. Pogue, vice president of the Chase National Bank and an authority on petroleum economics.

Mississippi's rise from its current position as the twelfth ranking state in petroleum production to seventh or even sixth place would not be surprising, Pogue told the bankers, particularly if a sound conservation program is entered in the statutes.

"We have heard often that the oil industry of the United States has reached the limit of its growth and the search from now on will prove less productive," said Pogue. "This note of defeatism does not reckon with the vigor and dynamism of American technology. It will find no acceptance in the states of the Southeast, enlivened and stirred into great activity by the events of the great war. In the belt that sweeps around the roots of the Appalachians through Mississippi, Alabama, Florida, Georgia, and South Carolina, the area underlain by rocks of Cretaceous age and under cover of younger geologic formations embraces approximately 155,000 sq. miles, or over 10 per cent of the entire area of the United States in which oil fields may be expected to be found. The corresponding area in Texas and Louisiana is about 130,000 sq. miles, yet records show that 14,000,000,000 bbl. of oil have been discovered. Lest this analogy be viewed too literally, let me hasten to add that the zones favorable for accumulation of oil are fewer in number and the thickness of sediments less great in the segment east of the Mississippi than in the coastal belt of the great oil states of Louisiana and Texas. Nevertheless, the points of resemblance must receive consideration."

Pogue pointed to the Tinsley field in Yazoo County as an example of the state's rise as an oil producer. Discovered in the summer of 1939, Tinsley underwent rapid development and in 32 months reached a peak of 96,000 bbl. per day. To date, this field has produced 70,000,000 bbl. Since its new peak in April of 1942, Tinsley has steadily declined in rate of output to a present level of around 35,000 bbl. per day, which is only 36 per cent of its highest level.

Pogue explained that oil fields decline prematurely because the natural propulsive forces are exhausted more rapidly than the oil is withdrawn. This diminution of flow, he said, was inevitable if a field is too closely drilled or its rate of production is permitted to exceed the optimum rate — "that rate which best fits all the circumstances."

The lost oil often totals as much as a third of the oil recovered, Pogue continued, citing the practice of oil operators in holding down the flow of oil wells to proper rates in order to gain maximum recovery. Tinsley would ultimately produce slightly over 100,000,000 bbl. and might have made a better record if the production rate had been more conservative.

Pogue pointed out that Mississippi is not favorably positioned to meet its needs as a rising oil state because of the lack of competent conservation law. Pending enactment of an adequate statute, he urged the state Oil and Gas Board to take full advantage of powers of the Petroleum Administration for War in implementing conservative spacing of wells and optimum rates of withdrawals from reservoirs.

"By emphasizing the necessity for fair and equitable treatment of all producers by means of ratable takings on the part of buyers and transporters," he said, "the state Oil and Gas Board can greatly facilitate the transition period to the resumption of full oil responsibility by the state."

Majors Blamed for Creating Oil Shortage

WASHINGTON.—Charges that major oil companies dominate and control the Petroleum Administration for War, are causing the oil shortage by failure to produce their reserves, and are operating as a cartel in violation of the antitrust laws were made in the House last week by Representative Jerry Voorhis of California.

In a lengthy prepared speech, Voorhis attributed most current petroleum problems to alleged monopolistic acts of the majors and failure of the administration to follow policies contrary to the interests of the big oil companies.

The basic cause of the present oil shortage, he said, is the policy of the majors in squeezing out independent producers and geologists, buying up leases on favorable producing areas, and withholding leases from drilling and production. He advocated a government study to determine the crude reserves of this country and action to give independent producers greater access to these reserves.

The Californian, who is one of the leaders of the so-called liberal bloc in the House, criticized the system of exempting the industry from the antitrust laws for certain group actions taken with the approval of the Government, criticized suspension of the antitrust suit against the American Petroleum Institute and major companies, questioned the propriety of settlement of the Elkins Act pipeline suit by consent decree, advocated government construction of common-carrier pipe lines, demanded condemnation of private holdings in the Elk Hills naval reserve, and suggested that the Government should obtain a controlling voice in the policies of oil companies operating abroad.

Texas Gulf Buys Control of Snowden & McSweeney

FORT WORTH.—Controlling interest in Snowden & McSweeney Co., one of the oldest oil-producing organizations in Texas, has been acquired by Texas Gulf Producing Co. through purchase of the interests held by the James H. and George G. Snowden estates, representing two-thirds of the 42,000 shares. The remaining one-third is retained by Henry McSweeney, of Atlantic City. The consideration involved in the transaction was not disclosed.

Texas Gulf will continue to operate Snowden & McSweeney Co. under its old name and will maintain headquarters in Fort Worth. The company has a daily gross production of 3,200 bbl., most of it in Texas, but owns wells in Oklahoma, Kansas, New Mexico, Mississippi, Kentucky and Illinois. Gordon W. Reed of Greenwich, Conn., president of Texas Gulf, was made president of the other company also.

Record String of Pipe Cemented in Pecos Well

The longest string of casing ever cemented in a well was landed last week on bottom at 15,270 ft. in Phillips Petroleum Co. 1 Price, 25 miles southeast of Fort Stockton, Pecos County, Texas. The casing, 5½-in. special mill pipe, was landed at 11 p. m. May 11 and cemented with 100 sacks. Cement was of special type and pretested in laboratory equipment for setting temperature and other characteristics.

With maximum pressure of 2,800 lb., the cement was pumped in the hole in 29 minutes and the plug followed to setting depth in 69 minutes, making a total elapsed time of 1 hour and 38 minutes for the complete cementing job. Phillips officials planned to start testing operations this week, probably starting this phase of operations by perforating pipe in the lower part of the hole.

Stanolind Buys San Andres Holdings in Slaughter Pool

FORT WORTH.—Holdings of San Andres Production Co. in the Slaughter pool of Hockley, Cochran and Terry counties have been bought by Stanolind Oil & Gas Co. for an unreported consideration. Properties acquired are in the northeastern part of the Hockley County portion of the pool, second largest in the state in area.

Stanolind also obtained the Alowine lease in Labor 12, League 41, Maverick County School Land, with two wells and May allowable of 1,608 bbl.; Caddell lease with five wells in Labor 31, League 39, with May allowable of 3,984 bbl., and the Mary McRea lease in Labor 32, League 40, with one well on a monthly allowable of 967 bbl.

Mid-Continent A.P.I. Agenda Covers Pertinent Topics

Availability of drilling and production materials, shortage of skilled manpower, job design, and foreman training will be among subjects on the program for the spring meeting of the Mid-Continent district of the American Petroleum Institute's Division of Production in the Mayo Hotel, Tulsa, May 25 and 26, according to announcement of J. S. Montgomery, Phillips Petroleum Co., Oklahoma City, program chairman.

Hungary Rising Rapidly As Petroleum Producer

BUDAPEST. — Although Hungary's oil industry is only 7 years old, its crude production in 1943 is reported as about 7,433,000 bbl., almost twice the figure for 1941. Only Rumania, and possibly Austria, rank ahead of Hungary now as oil producers. Hungary has cooperated closely with Hitler, so it is believed that production of oil which the Nazis need has been faster than sound engineering practice would approve. There are no signs that the production trend can continue to rise.

In the southwestern corner of Hungary the Budafapuzsta and Lovaszi fields yield high-quality light-gravity oil, from which a high percentage of motor fuels but small quantities of lubricants are obtainable. Fields in this area, developed by a subsidiary of a United States company, are now operated on behalf of the government under Nazi pressure.

A small government-operated field in northeast Hungary, at Bukkszek, has small production and prospects are not encouraging. The Germans are said to be seeking oil in various parts of the country.

Ungarisch-Deutsche Erdolwerke A. G. (Hungarian German Oil Works Co.), has been formed, with a capital of 10,000,000 pengos, to work a large concession on the left bank of the Danube, formerly held by private interests. It is known to be a gas-producing area.

Before the war Hungary's refining capacity was 3,716,500 bbl. annually, and it is believed that much of the country's crude must still be refined abroad, probably at Fiume and Trieste in Italy, and in Czechoslovakia, and in the Polish refineries, where production is below refinery capacity. A refinery in Almasfuzito is reported to have been modernized recently. A refinery and transshipment center was started near Komarom, on the Danube, but whether it is in operation has not been reported.

With a peacetime yearly consumption of about 2,229,900 bbl. of petroleum, Hungary probably has a large exportable surplus.

George J. Hanks, vice president and director of Tide Water Associated Oil Co., has resigned to become a vice president and director of South Penn Oil Co. He will manage the Bradford district operations of South Penn with offices in that city and Pittsburgh. He succeeds the late C. F. Stevenson. Hanks has resigned also as president and manager of Tide Water Pipe Co., Ltd., and Tidal Pipe Line Co., but will continue as president and director of Bradford Transit Co. which he was instrumental in organizing.

THIS WEEK

DRILLING—Regional meetings are under way to acquaint new contractors with War Labor Board wage-ceiling orders . . . . The nonconforming fringe of contractors is accused of labor pirating by ignoring established wage brackets . . . . Contractors losing men to the "one-well" high-paying drillers . . . . ¶Deferments, contractors assume, will be less difficult under revised induction regulations—may ease threatened pinch but manpower is still most acute field item . . . .

PRODUCTION—Navy swings support behind drive to increase current production from Elk Hills reserve . . . High officers testify that 50,000 bbl. daily will be needed next year to bolster West Coast supplies . . . . ¶Two more producing properties in Texas sold, one to a major and the other to a semimajor company . . . .

PRICES—Congressmen's efforts to tack petroleum-price amendment to price stabilization bill in committee apparently lost . . . . Sponsors told ample opportunity for amendments will develop on the floor . . . ¶Fred Vinson continues study of subsidy payments, decision expected almost daily . . .

TRANSPORTATION—First 100-octane movement through 20-in. WEP products line moving to East Coast . . . . If experiments with 275,000-bbl. batch are successful, more of same traffic will follow . . . . ¶Tank-car shipments last week to East Coast declined to 664,672 bbl. daily, a drop of 55,296 bbl. . . . . Reduced demand for heating oils is factor in decline . . . . ¶Sinclair Refining Co. connecting Lost Soldier and Wertz fields to its refinery at Sinclair, Wyo.

INTERNATIONAL—Organization continues of staff to aid Senator Maloney's special petroleum-policy committee . . . Congressmen reported chafing at delays in inauguration of public hearings . . . . ¶Petroleum Administrator Ickes makes another defense of Petroleum Reserves Corp. program in Middle East . . . . John A. Brown and George A. Hill, Jr., continue attacks, supported by former World Court justice . . . . ¶Foes appear to be in watchful waiting, ready to pounce on any new developments favoring either side . . . .

REFINING—Midwest refiners again asked to increase runs of West Texas sour crude . . . . Statistics show 140,000 bbl. of idle capacity in Middle West must be put to processing, if war demand for products is met . . . . Current operations include 35,000 to 36,000 bbl. daily of West Texas crude charged at Middle West plants . . . . Increase of more than 100,000 bbl. per day indicated by projected program . . . . ¶Gulf Coast independent refiners continue liquidation of gasoline stocks . . . .

While a Coast Guard combat cutter stands watch to ward off any attack, another fighting ship takes on a load of fuel from a tanker somewhere in the Atlantic. A line is fired from one craft to the other and an oil hose passed to link the warship's tanks with the tanker's fuel containers

Acme Photo

Reservoir Control and Behavior Discussed at A.I.M.E. Meeting

by E. H. Short, Jr.

HOUSTON. — Discussions of reservoir control and behavior of oil fields under various operating conditions featured last week's meeting here of the Petroleum Division, American Institute of Mining and Metallurgical Engineers. The Petroleum Division conferences were held in conjunction with a regional meeting of the general A.I.M.E. membership.

Fuller use of productivity indexes and material-balance calculations was suggested in two of the technical papers for projecting the performance of petroleum reservoirs. Utilization of the available data, it was suggested, may aid materially in selection of equipment and in predicting the results, particularly of pressure-maintenance operations.

Abstracts of other technical papers presented before sessions of the A.I.M.E. Petroleum Division on page 79.

Meaning of Declining Productivity

A declining productivity index, if not recognized, it was explained in a paper by C. V. Millikan, chief engineer, Amerada Petroleum Corp., and Herbert F. Beardmore, chief engineer, Barnsdall Oil Co., may be interpreted as an unsettled or unstable condition in a producing well. When an unsettled or unstable rate of flow of bottom-hole pressure is determined to be a declining productivity index, the results of the test may be interpreted to aid in estimating reserves and in planning future operations. It is usually a hyperbolic curve and is most conveniently presented by plotting productivity index against time on logarithmic paper.

A receding productivity index, the authors pointed out, forms the basis of a number of predictions, such as: (1) The rate of oil production will decline more rapidly; (2) the gas-oil ratio will usually increase abnormally; (3) the amount of water ultimately produced will be negligible, if any; (4) stopcocking will increase current production and decrease gas-oil ratio.

When such well performance is indicated, it follows that certain reservoir performance and operating practices may be anticipated: (1) The ultimate oil recovery will be lower than expected for a gas drive reservoir; (2) wells will flow naturally to a lower reservoir pressure and a lower rate of production; (3) there will be no active water drive; (4) acidizing, shooting, reworking can be better evaluated; (5) wells will produce as much oil and probably more by shutting them in from 10 to 40 per cent of the time; (6) smaller pumping equipment will be required and wells can be operated alternately.

Gravitational Displacement

A study of gravitational displacement rates which may be used as an index to determine permissible production without water coning was reported by P. T. Amstutz, Jr., petroleum engineer, Standard Oil Co. of Ohio, and Dr. Eugene A. Stephenson, department of petroleum engineering, University of Kansas.

The study of many well histories, Amstutz and Stephenson reported, revealed that, in most instances, the productivity indexes have decreased somewhat over a period of several years. Contrary to this general behavior, however, wells frequently evidenced a temporary increase in productivity about the time water first appeared. Continuous pumping tests supervised by the authors show that the percentage of water produced is often a direct function of the rate of fluid withdrawal. The possibility of interference between wells was investigated, not solely because it seemed to offer a complete explanation of the variations in well behavior but partly because of its bearing on the question of well spacing, and also because the technique, equipment, and the wells were already available owing to the completion of certain other studies conducted in the same area. Tests prove, the authors reported, that water recedes from idle wells, and is gradually replaced by oil. The process is known as gravitational displacement.

Material-Balance Equations

Development and application of a least-square-analysis procedure for the study of deviations in estimates of oil reserves as given by the material-balance equations was reported in a joint paper by Morris Muskat, Gulf Research & Development Co., and Rex W. Woods, who is now employed by Petroleos Mexicanos.

The data used were obtained from field observations on the Jones sand in the Schuler pool, Arkansas, and the Monroe dolomite in the Reed City pool, Michigan. Possible effects of water intrusion were taken into account by expressing the cumulative water influx in terms of various functions previously proposed in the literature. Formulas were developed and values established for minimal percentage deviations in the calculated reserve from the average values as could be obtained by suitable choice of the water encroachment and initial gas cap volume parameters. The results show that the fluctuations in the calculated reserves are very insensitive to the values chosen for the rate of water intrusion and initial gas-cap volume, and hence cannot be safely used in discriminating between spurious values for these parameters and such as actually pertain to the producing reservoirs. Moreover, the exact form of the wa-

Officers attending the annual spring meeting of the Petroleum Division, A.I.M.E. at Houston May 8, 9 and 10, included: I. W. Alcorn, chairman, Gulf Coast Section; C. A. Warner, permanent trustee; W. S. Morris, chairman, Petroleum Division; H. F. Beardmore, regional vice chairman, Petroleum Division, and Harold Vance, secretary and treasurer

ter intrusion function seems to have but little effect on fluctuations in the estimated reserves.

Accordingly, Muskat and Wood conclude that the material balance method cannot be satisfactorily used in determining the basic physical unknowns of producing reservoirs or in making conclusive decisions regarding the production mechanism, unless independently established geological-control data are available for eliminating unreasonable values for the reservoir parameters even though they may still satisfy the material-balance formulas. If, however, from core or logging data the initial oil reserves and the gas-cap volume can be established in advance, the material-balance formulas can be inverted to find the water intrusion. Moreover, by determining such calculations the water-intrusion coefficient, future production performance can be predicted by the aid of the material-balance formulas for specified operating conditions. This type of application may be of particular value in predicting the results of pressure-maintenance operations.

Lafitte Field Characteristics

Harold Vance, head of the petroleum engineering department, Texas A. & M. College, described the structural and oil-sand characteristics in the Lafitte field, Jefferson Parish, Louisiana. Most of the 35,000,000 bbl. of cumulative production has been withdrawn from five sands in the Miocene ranging in thickness from 28 to 52 ft. Three pay zones have gas caps but this energy is being conserved and the highly efficient water drives used in all five oil sands.

Paul Weaver, Gulf Oil Corp., explained how limestone fields in northern Mexico were produced by "stripping" after flush output subsided. High back pressures were maintained, cutting withdrawals to rates of 1 to 2 per cent of flush output. Under these conditions, he said, the decline curve was maintained at about 15 per cent annually.

Joseph A. Kornfeld, consulting geologist, reported a rapid increase in the percentage of dry holes occurring in development drilling in Kansas. He explained that the extensive wildcat drilling campaign has lifted the statistical number of discoveries to new peaks in recent months but that new pools are considerably under previous average size and that drilling depths are increasing sharply.

Petroleum engineering courses in colleges and universities were reviewed by H. H. Power, University of Texas, who also dealt with the socialized side of the profession.

S. R. Bolles, who was assistant superintendent of the Latonia, Ky., refinery of The Standard Oil Co. of Ohio, has been made superintendent, succeeding **A. H. Buchanan.**

Bureaus Vie for Authority in Probing Natural-Gas Industry

WASHINGTON. — An investigation of natural-gas resources and uses is desired by both Federal Power Commission and the Interior Department, but each agency wants authority to conduct the investigation itself.

The views of the two agencies were expressed by Secretary Harold L. Ickes and Leland P. Olds, chairman of FPC, in letters to the Senate interstate commerce committee commenting on Senate Joint Resolution 92 introduced last November by Senator John H. Overton of Louisiana. The resolution calls for a 6-month survey by the Power Commission, with an appropriation of $30,000, to determine present natural-gas reserves and their depletion, market demand, waste and economical uses, and other matters helpful to Congress in drafting conservation legislation.

Both officials said more time and money would be required, and Ickes asked $250,000 for a 3 or 4-year study by the Bureau of Mines and Geological Survey. He declared that the Bureau of Mines has for many years maintained that an inventory of gas still in the ground is essential, has established methods of estimating known reserves, has determined availability of gas and efficiency rates of withdrawal in many producing areas, and has made studies of attending transportation problems. Although no funds have been appropriated by Congress for an over-all estimate of natural-gas reserves, bureau engineers have made hundreds of studies in individual fields.

Technical Studies Conducted

Many technical studies have resulted from long cooperation with the American Gas Association and the bureau has compiled monthly and annual statistics for production and utilization of natural gas and related products. Published annual data show marketed production of natural gas by states, consumption by major uses and interstate shipment by pipe lines. Since one-half our natural gas is associated in its production with oil, the work contemplated should include studies of oil fields producing an appreciable quantity of natural gas and the relation of oil to gas in operation of those fields, he said.

The bureau has much information on natural gas on Public and Indian lands, Secretary Ickes stated, and its geologists have mapped and reported on many structures containing principally natural gas, in addition to their explorations for oil.

Chairman Leland Olds, of the Federal Power Commission, asserts in his report that responsibilities for conservation and use of this resource rest with the commission, under specifications of the Natural Gas Act.

The commission has gained invaluable knowledge of the problems of the industry and of the consuming public, he said, and has many data concerning gas reserves, facilities, operations rates and costs, primarily with respect to natural gas companies under its jurisdiction. It has also gone into the question of the effect of the construction of natural gas-transmission pipe lines upon the interests of competing fuels, transportation, labor and related interests. The information thus far obtained is not complete, he said, but would provide substantial basis for a comprehensive study.

Need for an investigation was reported by the committee in 1940 and the suggestion was made that careful study of the entire problem may lead to the conclusion that use of natural gas should be restricted by functions rather than by areas. That the Natural Gas Act be broadened to give the commission adequate power to resolve conservation problems in the public interest was proposed by the commission at that time.

The question whether rapid depletion of the country's natural-gas reserves may not reduce for all time the country's potentially recoverable reserve of oil is the most fundamental question involved, he said.

The FPC report concluded that the time allowed by the resolution for the study would be insufficient and that the appropriation provided may prove to be inadequate.

WSA Fixes Rates From Gulf to North Atlantic

WASHINGTON.—A rate of 40 cents a barrel, with surcharge of 103 per cent, has been authorized by War Shipping Administration for movement of oil and oil products in bulk by tanker of 3,000 tons or more from Gulf ports to ports on the Atlantic Coast north of Cape Hatteras and not east of New York, for export.

WSA also fixed 45 cents, with 100 per cent surcharge, as the rate for movement from the Gulf to the Portland pipe line for export, and 49 cents and 144 per cent to Halifax, Nova Scotia.

World Court Judge Blasts Petroleum Reserves Policy

by John P. O'Donnell

NEW YORK. — Petroleum Reserve Corp.'s policy was condemned by an outstanding, disinterested authority when Judge Manley O. Hudson, judge of the World Court and Bemis professor of international law at Harvard, spoke before the Economic Club here last week. PRC and the Arabian pipe line were upheld by Petroleum Administrator Harold L. Ickes and condemned by John A. Brown, president, Socony-Vacuum Oil Co., Inc., and George A. Hill, Jr., president, Houston Oil Co., on the same program.

Judge Hudson did not refer to the corporation by name but his inference was clear when he said, "We can adopt a policy for the postwar period of attempting to control reserves in various parts of the world and of locking them up for our national interests. It is a policy which will almost inevitably embroil us in far-flung political complications, and as it can be emulated by other dynamic peoples it might bring us into dangerous rivalries. It would very probably expand the scope of governmental activity and it might throttle private initiative in the field in which American business has its best claim to preeminence."

Judge Hudson, who served as an adviser to the foreign operations committee of the industry, upheld its suggestion of an international agreement comparable to our interstate oil compact. He said that a draft of a resolution calling for international cooperative approach to the oil problem is before the International Labor Conference meeting in Philadelphia.

As a basis for his contention, Judge Hudson cited the unique character of oil among commodities. "All peoples are its consumers, and in many countries the national economy is geared to its availability. Yet the known sources of oil are concentrated in only a few parts of the world, and few peoples have mastered the technique for developing them and for converting the natural riches into usable products. In large part, the oil deposits of the world are controlled and worked by nationals of only four or five countries.

"Add to these facts the relatively new appreciation of oil as an implement of war and its significance to national and international security, and I think it may not be too much to say that oil may be the touchstone of peace for the coming generation. If this is not an overstatement, it would seem to follow that a sound international policy on oil has become a sine qua non of any durable peace and of any world order based on law. The formulation of such a policy therefore is an essential condition of our winning the war."

"Creative Program" Proposed

Ickes offered a "positive, creative program" embracing stimulation of exploration, efficient use of available oil, insurance of access to foreign oil and stockpiling both here and abroad, in his talk. The Arabian pipe line was linked to the third point since it "would offer a western outlet to American controlled oil from the Persian Gulf" and would give "the American public and our armed forces an important additional source of oil."

He pointed to the similarity between his views and those of the industry, noting that while their broad objectives were the same the methods of accomplishing them were the basis of difference. He added, with possible significance, that the proposed pipe line is "only a single, and not too important, item" in a comprehensive policy.

Brown viewed PRC as a threat to the well-established position of American nationals in foreign oil reserves. "The entrance of this Government into other nations' territory as owner and operator of oil fields or transportation systems, in whole or in partnerships, will create tension in the countries thus invaded and in all other producing or potentially producing countries, who would fear such foreign-government invasion."

The "open-door" policy of our State Department "although not completely successful with all countries, has helped American oil companies to compete in the development of oil areas in other parts of the world," he said: "Without threat of force, and without force ever being exercised, our nationals have been able to hold their own with foreign enterprises, even in those regions designated as some other country's 'sphere of influence'."

Ten-Point Attack

Hill attacked PRC on the basis that (1) it is a postwar project organized by executive direction as a subsidiary of a war-emergency corporation; (2) its plans, powers and program were not submitted to and its funds not appropriated by Congress; (3) it planned to execute an imperialistic foreign policy; (4) its program tacitly implies violation of the territorial integrity and sovereignty of certain foreign countries and interference in their internal affairs; (5) it violates American fundamentals in launching government into private business in the guise of war emergency; (6) it instigates international complications and is a potential breeder of war; (7) it generates and promotes suspicion, distrust and disunity among our allies; (8) it violates democratic processes in proceeding in defiance of Congress and its pending investigation; (9) its mode of organization and action impeach the responsibility and authority of the State Department; and (10) implied is a delegation to PRC of the function and duty of the President to remove the claimed British threat to American interests in the Middle East ("if such in fact exists and which I do not believe") instead of a full and direct resort to prompt diplomatic processes such as are now in actual progress.

Cities Service Must Dispose Of Either Oil or Utilities

PHILADELPHIA. — Choice of disposing of either its utility interests or its "vast and complex" oil business and other nonutility enterprises, is accorded Cities Service Co. by Securities and Exchange Commission, which rejected the company's contention that its oil operations were "reasonably incidental or economically appropriate to" its utility projects. The decision is contained in the commission's opinion and order regarding the integration of Cities Service and its subsidiaries, which represent more than $1,000,000,000 under the Public Utility Holding Company Act.

Literal compliance with the commission's order would require Cities Service to divest itself of all other properties and interests in a system which operates in every state of the Union and in several foreign countries, comprising more than 100 companies.

Commenting on the effect of its order, the commission says: "The vast and complex oil business and the gas-utility operations of the system have been found to be incompatible. If Cities Service desires to retain its oil business, it cannot remain in the utility business."

FOUNDED IN 1910

BY PATRICK C. BOYLE

the OIL AND GAS JOURNAL

Renew the Offensive

THE offensive looking to generally higher prices for crude oil, with offsetting advances in product quotations, needs to be renewed. Never was the justification more apparent.

Some have assumed that the price administration's plan to grant subsidies to stripper-well operations ended any possibility of a general increase. Their proposal for the wells of smallest production has little bearing on conditions demanding higher returns for the entire industry.

While wells under 9 barrels daily account for 65 per cent of the total, collectively they produce less than 10 per cent of the current output. They represent either the industry's efforts to secure the last drop commercially obtainable from old wells or operations which from the start were based on small production per well.

If higher prices for crude oil were simply a matter of gradation, then unquestionably these stripper wells should receive first consideration. Higher schedules are justified by every factor involved and are mandatory if the conservation principles involved are to continue in effect.

But stripper wells are not now and never have been the controlling factor in petroleum operations. They are the backlog, not the frontlog, of the industry's activities. The stimulus for constant expansion and the impetus which has enabled operators to solve all problems in stride have come from wells capable of producing 9 to several hundred barrels of crude oil daily. Operators of these wells have borne the brunt of the emergency requirements so far, and upon them rest the responsibilities of the future. Any planning which ignores these fundamental conditions will prove disastrous.

The price administration in the latest attempt to justify its oil-price position contends that the profits from these nonstripper operations are sufficient. They also stress the fact that wildcatting has increased.

These excuses are typical of the bureaucratic approach to the industry's price and operating problems. The larger earnings of the industry's integrated units are partially due to refining and marketing operations. Mostly they represent greater volume. When operators increased their crude-oil output 10 to 50 per cent last year and brought oil to the surface which normally would be produced over a period of years their gross and net return expanded. But in most cases these profits are more a liquidation of assets than an accurate reflection of current earning positions.

The real test is whether or not the crude oil is being replaced with new reserves and whether it can be replaced at present prices. To justify today's increase of 550,000 bbl. daily in crude-oil output over year ago new oil aggregating 3 billion barrels should have been found during the past 12 months. Discoveries fell far short of that objective and the costs of the new oil that was found were substantially in excess of today's markets.

Nor is the number of wildcat wells being drilled the sole criterion of whether exploration programs are sufficient. There have been years when a few hundred tests were sufficient. To take care of the deficiencies of recent years and the assured demands of the future, exploration must be expanded as never before, not only as to number of tests but also as to areas.

Legislative Washington sees and understands these basic conditions much better than it did a year or two years ago. There is every reason to believe it will force action from an adamant administration if the industry continues to push its case.

GAS MEN AGREE ON PROGRAMS

Natural Gas Conference Delegates Discuss Means of Improving Wartime Service and Strengthening Postwar Operating Positions

by C. O. Willson

FRENCH LICK SPRINGS, Ind.—Producers, transporters and distributors of natural gas at their spring conference here May 11-13 discussed methods of giving maximum service over the remainder of the emergency and laid plans to strengthen their operating positions in the postwar period. It was the first meeting since the reorganization of the natural-gas department of the American Gas Association and programs were agreed upon which will effectuate the changes announced earlier in the year.

Ernest R. Acker, A.G.A. president and president of Central Hudson Gas & Electric Corp., said the object of the reorganization was to "streamline the entire industry" by coordinating the natural-gas and artificial-gas divisions. It is expected that a director for the natural-gas department will be announced in the immediate future. A number of men are under consideration. Plans call for the employment of a natural-gas engineer to direct the technical work of the department and also an economist to be in charge of an enlarged statistical division. E. Holly Poe, former director, and now engaged in private business, attended the conference.

Reports presented at the conference showed that practically all activities of the natural-gas industry have been expanded to record proportions. This year, it was stated, will witness a production in excess of 4 trillion cubic feet with a marketed production of approximately 3½ trillion cubic feet. Of this total 2 trillion cubic feet will be accounted for by utility uses as reported by A.G.A.

It is conceded that the end of the war, for a time at least, will bring substantial declines in the industrial demands for natural gas which have expanded rapidly over the past 2½ years. The recommendations of committees which have conducted investigations regarding the postwar needs of the industry were presented.

They call for larger expenditures than ever before for advertising and educational programs designed to strengthen the competitive position of natural gas, particularly in regard to household use. It is also planned to expand the research projects of the association whose accomplishments to date point to new postwar products from gas and which also have contributed to operating efficiency in transportation and distribution.

As a result of a study of natural-gas resources of the United States, Lyon F. Terry, second vice president of Chase National Bank, predicted at the conference that future discoveries would be at least as large as the reserves discovered to date which total approximately 200 trillion cubic feet. With the reserve of 110 trillion cubic feet estimated at this time his analysis pointed to a future supply of 300 trillion cubic feet or more.

Terry's analysis showed that at the end of 1943 the proven reserves with an annual output of 4 trillion cubic feet bore a 27.5-to-1 relationship between reserves and production. He pointed out that most of the reserves came from the Panhandle, Hugoton and Kettleman Hills fields, all discovered in recent years. The ratio of new reserves to production largely due to these discoveries from 1926 through 1934 was 2.74 to 1.

The significance of deeper drilling in relation to the discovery of additional natural-gas reserves was emphasized by Terry. "Other things being equal," he explained, "an acre-foot of pore space filled with dry gas encountered at a depth of 10,000 ft. should contain roughly 1¾ times the quantity of gas in a similar reservoir at 4,000 ft. In the oil fields, the ratio

Members of the managing and advisory committee, Natural Gas Department, meeting during last week's spring conference. Seated: (left to right) Major Alexander Forward, managing director A.G.A.; A. F. Bridge, Southern Counties Gas Co.; G. J. Neuner, Kansas City; William Moeller, Jr., Southern California Gas Co.; Honoria Moomaw, secretary, Natural Gas Department; J. French Robinson, department chairman and vice president, A.G.A., East Ohio Gas Co.; H. J. Carson, Northern Natural Gas Co.; C. H. Zachry, Southern Union Gas Co.; D. P. Harison, Equitable Gas Co.; E. P. Noppel, Ebasco Service, Inc.; E. L. Rawlins, Union Producing Co.; H. D. Hancock, Cities Service Gas Co., and J. A. Brown, Commonwealth and Southern Corp. Standing: F. C. Brown, Natural Gas Pipeline Co. of America; R. H. Hargrove, United Gas Pipe Line Co.; F. H. Lerch, Jr., Consolidated Natural Gas Co.; D. W. Harris, Arkansas Natural Gas Co.; R. E. Wertz, Amarillo Gas Co.; C. E. Bennett, Manufacturers Light, Heat & Power Co.; D. H. Hulcy, Lone Star Gas Co.; R. W. Hendee, Colorado Interstate Gas Co.; Joseph Bowes, Oklahoma Natural Gas Co.; Paul Taylor, Stone & Webster Engineering Co., chairman of the natural gas department, Office of War Utilities, War Production Board; E. F. Schmidt, Lone Star Gas Co.; T. H. Kerr, Columbus, Ohio; Bruno Rahn, Milwaukee Gas Light Co., and Walter C. Beckjord, Columbia Gas & Electric Corp.

of gas in solution to the oil found in place varies with depth and pressure in a relationship similar to that of dry gas. Hence deeper drilling may be expected to reveal increasing proportions of solution gas per barrel of new oil reserves discovered in the future.

In this connection Terry discussed the gas importance of the increasing rate of condensate field discoveries. He pointed out that the discovery of this type of field in successful wildcat operations had increased from 7 per cent in 1933 to 52 per cent in 1943 when 36 condensate discoveries were reported.

Industrial Education

C. E. Lawall, president of West Virginia University, urged the natural-gas industry to provide educational opportunities and training courses for its employes, either by sponsoring the courses themselves or by cooperating with nearby colleges. He said greater proficiency in their work would result. He cited examples of what certain industries had accomplished by these programs with better workmen and greater cooperation on the part of employes in solving mutual problems.

Lawall, whose university has cooperated with the natural-gas industry in his state in providing courses also urged operators to recruit young technical men, "especially those who are research-minded, so that new techniques and methods may be continually developed."

Government Research

Dr. R. R. Sayers, director of the Bureau of Mines, outlined the research work that the bureau has conducted in past years and that which it has under way at this time. He pointed out that more information is needed regarding the cycle gases that will remain in the reservoir sands after the liquid fractions have been removed. He explained that eventually a gas-liquid will be changed into a reserve of relatively dry gas to be drawn upon for gaseous fuel and for raw material in chemical synthesis.

Sayers explained briefly the production of liquid products by the Fischer-Tropsch method of gas synthesis. The bureau has had promising results in small-scale experimentations. This work is being expanded in large-scale development projects with the view of determining possibilities in manufacturing diesel fuels and high-octane gasolines. He explained that the possible use of liquefied natural gas, high in methane, directly as motor fuel may have some relation to the liquefaction of natural gas which is stored and used as "makeup" to meet peak loads.

E. M. Borger, who recently returned to his duties as president of Peoples Natural Gas Co., Pittsburgh, Pa., told of his experiences in Africa and Italy while a member of the American Field Service.

Four of the six sessions of the conference were devoted to the practical operating problems of the natural-gas industry. Ten papers revealed that the underground storage of natural gas has become an important factor in natural-gas distribution at scattered points in this country. The reports showed that valuable information based on experience is now available in regard to the underground formations suitable for the storage of the gas. Some of the papers also discussed the economic factors involved in these programs designed to aid transporters and distributors in taking care of the seasonal and daily variations in consumer demands. E. G. Dahlgren, assistant secretary of the Interstate Oil Compact Commission, summarized the papers at the conclusion of the discussion.

Charles F. Turner, of East Ohio Gas Co., brought up to date the information on the liquefaction of natural gas at the company's Cleveland plant. This pioneer operation has been successful as standby source of gas supply and its capacity was increased last year.

While not discussed at the sessions it was apparent from opinions expressed here that many operators believe that the liquefaction of gases has commercial possibilities in addition to those established in the Cleveland installation. It is understood that investigations are under way looking to the liquefaction after the war of large quantities of excess gas to be shipped by boat to eastern population centers. It is proposed to use the liquefied gas to enrich artificial gas.

The symposium on the long-distance transmission of natural gas explained why many companies, in response to war demands, have been able to substantially increase the movement of natural gas through their lines. Several papers dealt with the problem of keeping the lines clean as a basis for maximum operation. New devices and new applications of existing practices have largely solved the problem for companies whose operations were explained at the conference.

CONFERENCE PAPERS

In the May 11 issue of the Journal were published the following papers presented at the French Lick Springs conference:

Chairman's address—J. French Robinson, Page 105.

"Natural-Gas Cycling and Its Significance to the Natural-Gas Industry," by R. W. Ducker and F. H. Dotterweich, PAW, Page 107.

"Freedom of Natural Gas in Interstate Commerce," by R. E. Wertz, Amarillo Gas Co., Page 109.

In this issue will be found two additional papers, on Pages 69 and 71.

A.G.A. ABSTRACTS

Additional abstracts of papers presented at the Natural Gas Spring Conference start on page 76. They deal with underground storage and long-distance transmission operations.

The Story of the McKamie (Ark.) Gas Cleaning Co.

C. W. COOPER, Vice President, Consolidated Natural Gas Co.

THIS report deals with the initial step into a new field in the science of natural gas. This is the development of an installation in which the hydrogen sulfide removed from sour natural gas is converted into free sulfur.

This new development has been made in the extremely sour McKamie gas field in southwestern Arkansas. The gas from these wells has an average hydrogen sulfide content of about 4,300 grains per 100 cu. ft. and in its natural state is completely unmarketable.

The new treating installation only went into full operation on March 8, 1944, and is still going through its growing pains. It is giving out a stream of molten sulfur amounting to 60 tons per day. And in addition, the plant is sending out large quantities of dry, sweet, fuel gas and butane, propane and gasoline.

The field is an isolated producing dome, approximately 3,200 acres in extent, one of many such pools now common in northern Louisiana and southern Arkansas. It lies in the Smackover lime at a depth of approximately 9,000 ft. and with an original bottom-hole pressure of over 4,000 lb. per sq. in.

The field has been drilled primarily for the production of petroleum distillate. Distillate, however, constitutes only about 7 per cent by volume of the reservoir content and the remainder of the production comes off as a very sour natural gas. This gas is predominantly methane and ethane, but it is rich in propane, butane and pentane and it is contaminated to an extreme degree with hydrogen sulfide.

Underground Storage of Natural Gas in the Medina Formations Of Western New York

JOHN REEVES, Republic Light, Heat & Power Co., Inc., Buffalo, N. Y.

THIS underground storage project of the Republic Light, Heat & Power Co., Inc., is in Chautauqua County, western New York. Starting in 1937 gas was injected for 3 years with very little gas withdrawn. The net balance stored at the end of the 3 years was 1,500,000,000 cu. ft. Over the past 5 years the stored balance has varied as to demand and the availability of gas for replenishment. The total gas handled in and out of storage has been approximately 3,500,000,000 cu. ft.

Very little was known of the formations when the project was started. The wells available for storage produced from the Medina series which are composed of sandstone and are of the blanket type. The accumulation of gas in closed units or "pools" is not controlled by structure or by the presence of water. Gas has been injected in three different units with satisfactory results in two units. The third is

being abandoned because it was found that although gas could be put into the wells in satisfactory volumes with a large differential between static reservoir pressure and input flowing pressure, the volumes the wells will deliver with a lesser differential between static and flowing pressure was much smaller than the intake.

Recent Trends in the Dehydration Of Natural Gas

THOMAS S. BACON, Research Engineer, Lone Star Producing Co.

THE art of dehydrating natural gas is reviewed generally. The importance of operating labor costs is reemphasized, and examples are given of plants operating in the field with a minimum of skilled attention. Proper conditioning of the raw gas before entering the dehydration plant proper is discussed. Close control of gas temperature, and removal of entrained liquids and solids, before the gas enters the dehydration plant itself, are essential for continued satisfactory operation.

A secondary benefit obtained from dehydration is increased line capacity due to (a) absence of liquids in the gas-transmission line, and (b) maintenance of smooth internal pipe surfaces.

Factors affecting this increased line capacity have not been accurately evaluated, but should be investigated further. The lack of a satisfactory device for recording the degree of dehydration obtained in operating plants is mentioned.

Michigan Natural Gas Storage Project

By Michigan Consolidated Gas Co.

THIS project is located in Austin Township, Mecosta County, in the Lower Peninsula of Michigan. It receives gas from three fields and delivers to a line serving Grand Rapids and other Michigan points. The gas reservoir is a sand bar formed on a shoal in an ancient shallow sea. It is lenticular in character and is commonly called Michigan stray sand. It is 3¼ miles long and 1 mile wide. The maximum sand thickness is 40 ft. and the porosity 20 per cent.

Thirty-one wells have been drilled in and around the field of which 22 were producers and 9 dry holes. The average well is 1,400 ft. The original pressure was 520 lb. At the start of the repressuring it had dropped to 288 lb. Gas injection was started in April 1941 and when 4,200,000,000 cu. ft. had been injected the pressure rose to 505 lb. Only limited quantities of gas have been withdrawn in the past winter seasons, and the present range of pressures is 425 lb. minimum to 525 lb. maximum. The existing wells at 500 lb. have a daily output capacity of 100,000,000 cu. ft.

Underground Storage of Natural Gas in La Goleta Field

MARION L. FORT, Pacific Lighting Corp., Los Angeles.

LA GOLETA field is on the Pacific Coast in Santa Barbara County, 105 miles northwest of Los Angeles. It is an anticlinal structure complicated with faulting. The production zone is Vaqueros sandstone of 20 per cent porosity averaging 300 ft. in thickness and is 4,000 ft. below sea level. The area is 295 acres. The first dry gas well was drilled in 1929 and 4 wells were completed. Before storage operations started in 1941, 15,300,000,000 cu. ft. of gas were withdrawn. Three of the wells were killed and old fittings replaced with connections capable of 3,000 lb. working pressure. Four 650-hp. and one 300-hp. compressors with a maximum discharge pressure of 2,500-lb. were installed with a capacity of 30,000,000 cu. ft. daily. Injection rates are to be increased to 66,000,000 cu. ft. daily with a withdrawal rate of 200,000,000 cu. ft. daily. Storage is used to equalize seasonal and daily changes in demand in Los Angeles.

Results show that gas injected does not readily commingle with virgin gas in structure. Cooling before injection was discontinued when it was found that the temperature of the injected gas would not readily equalize with temperature of gas in structure, causing formation of hydrates. Problem of gas measurement due to formation of hydrates was solved by wrapping the gage lines with electric heating cord and covering with insulation.

Liquefying and Storing Natural Gas for Peak Loads

CHARLES F. TURNER, East Ohio Gas Co., Cleveland, Ohio.

THIS paper brings up to date, based on 3 years' experience, the results obtained in the operation of the gas-liquefaction plant of the East Ohio Gas Co. which markets natural gas in Cleveland. (See The Oil and Gas Journal, Oct. 17, 1940, p. 48; March 20, 1941, p. 46; and May 8, 1941, p. 57.) Capacity of the plant was increased last year 50,000,000 cu. ft. to 140,000,000 cu. ft. through the installation of a cylindrical tank 70 ft. in diameter and 42¾ ft. high. It has double-dished bottom and top to provide for expansion and contraction and is insulated with 3 ft. of granulated rock wool between the inner tank and outer enclosing shell. The liquefying rate is 3,000,000 cu. ft. per 24 hours and the regasifying rate is 4,000,000 cu. ft. daily.

Columbia System's Underground Gas-Storage Operations

GEORGE S. YOUNG, Vice President, and J. E. OVERBECK, Gas-Measurement Engineer, Columbia Engineering Corp.

THIS report deals with Columbia Gas & Electric Corp.'s accomplishments in underground storage and discusses problems whose solutions might improve the operation. Underground storage properly applied, according to the authors, permits the gas-transmission lines between sources of supply and markets to be operated at higher annual load factors. It permits continuous operation of low-rock-pressure wells. The ideal storage project is located near markets and should yield the required peak delivery with the least quantity of gas in storage. It is economical to convert a suitable gas field to a storage pool before it has been depleted to a point where it holds less gas than is required for the so-called cushion.

Further consideration should be given to the use of smaller storage pools operated at higher pressures which results in a higher deliverability rate for a given quantity of gas in storage. It is desirable that gas injected into storage pools be practically free from any substance that may fill the pores of the producing horizon. Orifice-meter measurement errors, if any, resulting from storage pool compressor pulsations may be reduced to a point where they are negligible if recent findings on this subject are utilized.

Considerations Involving Performance of Gas Compressors At High Altitudes

G. F. BRUNSTON, chief engineer, Colorado Interstate Gas Co., Colorado Springs, Colo.

THE paper is concerned with the operation of six main-line stations located along the Amarillo-Denver line at altitudes varying from 3,700 to 5,200 ft. In any engine the cylinders are made of such size as to handle the proper amount of fuel mixture of certain air-fuel ratio. The ratio is about 10 to 1 in the case of 1,000-B.t.u. gas.

A cylinder of a given size designed for sea level must induct less air by weight the higher it is above sea level, due to the decreasing air density. The amount varies directly as the absolute pressures. Temperature has the reverse effect on the density. One of the main compensating factors is that when the maximum approach to sea level rating of the machines is desired the atmospherical temperature averages about 0° F. If we assume the original design basis as standard, i.e., approximately 14.7 lb. absolute, and 60° F., and take the station at an elevation of 3,900 ft. as a case in point, where full sea-level rating has been obtained during the winter, the application of the two air-density relations gives the following correction factor:

$$\text{Correction factor: } \frac{12.7}{14.7} \times \frac{520}{460} = .864$$
$$\times 1.13 = .976$$

It would appear from this that the decrease in temperature compensates almost entirely for the decrease in pressure. However, it is the condition of the inducted charge at the beginning of the suction stroke that counts.

The above applies to the aspirated engines. From this cycle the two-cycle engines are placed in this category because, although the scavenging system supplies at about 3½ lb., the manufacturers make no claim of any supercharging the cylinders. Of late one has suggested the possibility that, since there is an excess of air delivered to the power cylinders by the scavenging pump under pressure, there may be a supercharging effect. If this is the case this is another compensating factor.

DEATHS

J. A. Raley, 88, oil man and stock-farm operator, died May 9 at Bryson, Tex.

Fred M. Dooley, 72, who had extensive oil holdings, died May 9 in Houston.

Vernon Edler, 47, vice president and general manager of the Peerless Pump division of Food Machinery Corp., died May 1 in Los Angeles.

Cecil F. Sloane, 61, president and general manager of Sloane-Forsberg Oil Co., Oklahoma City, died May 9.

Henry Doss, 50, pipefitter for Standard Oil Co. of Louisiana, died May 9 in a Shreveport hospital. He resided in Baton Rouge.

Francis M. McMahon, 73, former auditor of Midwest Oil Co. at Denver, died in Chicago May 4. He was associated for many years with the late Verner Z. Reed and the late O. H. Shoup, of Colorado Springs in oil and mining interests.

John B. Jenkins, 48, auditor for The Texas Co. and in that organization's service 25 years, died May 12 in Houston.

Michael M. Klosson, 51, of Buffalo, N. Y., chief engineer for Buffalo Pumps, Inc., died in California April 11 while on a business trip. He was a director of the company.

Increased Oil Recovery by Gas Injection From Old Producing Sands at Salt Creek

by Neil Williams

Benefits to be derived by injection of gas into old producing sands facing early depletion of pressures are demonstrated in the results of such a project in the Salt Creek field. Present rate of injection into the two sands concerned is approximately 20,000,000 cu. ft. daily. As a result of the project, started in 1926, average pressure has declined less than 3 lb. during the past 10 years and daily oil withdrawals are being sustained at a rate estimated at double that which otherwise would be possible.

EXTRAPOLATION of pressure-decline rate curves of main producing sands in the Salt Creek field, Natrona County, Wyoming, prior to the beginning of gas injection in 1926, indicated that reservoir pressures in these sands would be entirely depleted by 1929 or 1930 and that sustained oil recoveries by conventional production methods could not be expected long after then. Gas injection, started at that time, has been continued without interruption since then with the result that pressure-decline rate curves have been flattened, and the sands still are producing approximately 14,000 bbl. daily, which is estimated to be nearly twice as much as they otherwise would be capable of yielding.

Average reservoir pressures of the pressured sands have declined only from 2 to 3 lb. during the past 10 years with fluid withdrawals from these sands during this period totaling approximately 57,000,000 bbl. Withdrawals from these sands since 1926 total approximately 108,000,000 bbl. Daily production, although about half what it was prior to the start of gas injection, has been maintained for some time approximately at its present level with reservoir pressures tending to become further stabilized. A large part of the drop in daily production and in reservoir pressure that has occurred since the start of gas injection took place during the earlier years after the program was initiated. At the present rate of pressure decline, assurance is given that the productive life of these sands will be extended over a number of additional years.

Principal sands involved in the pressuring project are the first and second Wall Creek horizons ranging in depth from 1,200 to 2,700 ft. Some gas has been returned to the third Sundance, a deeper formation. In addition there are a number of other producing horizons, including the Tensleep, which has been developed more recently. To date, however, the first and second Wall Creek sands have been the more extensive and prolific producing horizons of the field. Of these two, the second Wall Creek sand has been and is the most important oil producer, and approximately 90 per cent of the gas injected is to this horizon. Its production has been drawn on most heavily and its pressure most nearly depleted.

Major development of both sands had been almost entirely completed by the time gas injection was undertaken, and many wells already had been placed on the pump. Development started as early as 1908 and continued production over the intervening years had resulted in the withdrawal of substantial volumes of oil and gas. Peak production was reached in 1923 when daily withdrawals ran as high as 100,000 bbl. By 1925, production had dropped to 44,000 bbl. daily. By the latter part of 1926, when the injection of gas was started, it was down to between 28,000 and 30,000 bbl. daily. At that time, shut-in

Well hookup in Salt Creek field showing gas-gathering line leading from casing-head. Shown also are two calcium chloride "baskets" through which gas is passed to prevent freezing of water condensate in lines during spells of cold weather

One of approximately 200 gas-injection wells in the Salt Creek field

pressures of the wells averaged around 29 lb., as against estimated original pressures of about 800 lb. Total fluid withdrawals from the first and second Wall Creek sands up to then amounted to approximately 173,470,000 bbl. Of this, approximately 138,750,000 bbl. has been from the second Wall Creek sand.

The second Wall Creek sand, the main horizon, has only gas drive. A few wells make small quantities of water but this probably is of connate origin. Generally, no water is present. Drainage is downstructure, and many of the best wells, entirely water free, are located around the edges. Consequently, the wells are produced dry, and as they go dry progressively downstructure they are shutdown for possible later use as injection wells, or for possible recompletion in other sands. Few wells are abandoned. There is some evidence of a slight water drive in the first Wall Creek sand.

Gas recovered from these sands for injection is gathered from the well casing heads. Since pressures are down and all wells are in the pump, little gas is produced with the oil. The volume of gas thus obtained varies by wells from as little as 1,000 cu. ft. to as high in some cases as 100,000 cu. ft. per day. This gas, returned to the two sands, is augmented by the production from all other sands in the field.

The gas-injection program involves principally the unitized portion of the field, of which Stanolind Oil & Gas Co. is the operator, but this represents the major part of the productive area. Within the unit, there are 825 wells still on production in the second Wall Creek sand out of a total of 1,277 wells which have been completed. In the first Wall Creek sand, 149 wells remain out of a total of 238. Altogether, there are 1,080 producing wells in the unit with 1,639 wells having been completed.

Gas production of the unit, including that from the first and second Wall Creek and that recovered from other sands, now amounts to about 25,000,000 cu. ft. daily. Of this, 5,000,000 cu. ft. is required for field use and the remainder is returned to the sands being pressured. Approximately 90 per cent of this, as previously stated, is going to the second Wall Creek sand. The gas, being very wet, first is processed through a gasoline plant for recovery of liquid hydrocarbons. That produced from the Tensleep, the deepest and most recently developed horizon, carries a high content of hydrogen sulfide which necessitates separate initial processing through a small treating plant for sweetening. The volume of gas from this horizon, however, is comparatively small.

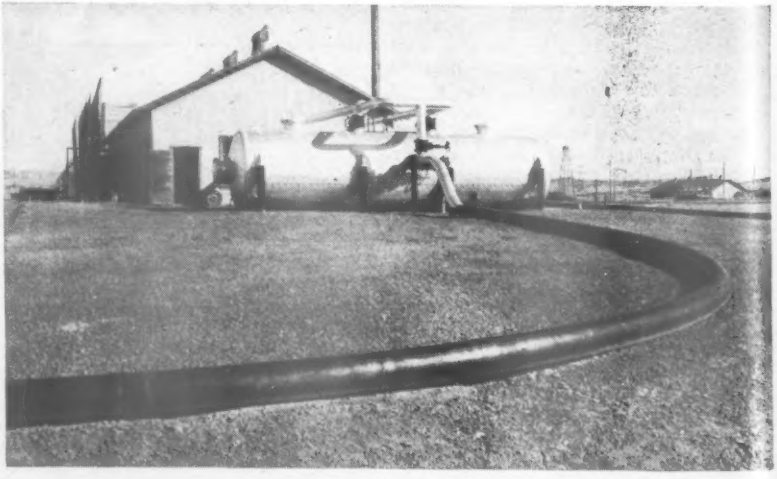
Casing-Head Gas Collection

Casing-head gas is collected by seven booster plants serving different sections of the field. Each has an 8-in. or 6-in. main line into the plant with 4-in. and 2-in. branch lines picking up the gas from the various wells in the section. The largest plant contains seven 165-hp. compressors. The other six stations have a total of 35 units of 80 hp. each. These plants, taking gas at reduced well pressures, discharge at pressures ranging from 8 to 18 lb. to the main, centrally located plant for gasoline extraction and delivery to the input wells. The central plant consists of five 970-hp. compressors. These pick up the gas from the booster stations at suction pressure of 4 to 5 lb. and discharge to the input wells at 125 lb.

At present there are approximately 200 gas input wells. These are picked from among the wells that have ceased to produce to give a uniform gas-injection pattern. They are changed from time to time as occasion requires and according to developments in the reservoir. This is one of the reasons the wells which go dry are not abandoned.

Oil production practices are designed to obtain the most effective recoveries consistent with the gas injection program. Most of the wells were completed with 7-in. casing for the oil string with 2-in. tubing. Fluid levels are low and, except in the downstructure edge wells, generally are below the top of the sand. Pumps in many cases are set in rathole below the bottom of the sand with the rathole serving as a sump for the oil. Straight plunger pumps with cups are most common although some inserts with small bore also are used. Most of the wells are pumped with standard rig fronts powered with electric motors, this being the type of equipment which has been in service in the field since the start of pumping. There also are some back-crank installations. Stanolind generates electric power which is used extensively in operating producing facilities throughout the field.

Pumping schedules vary greatly, depending upon the most effective results in the individual wells. Some are on 24-hour schedules; others are on 16-hour or 8-hour schedules, while still others may be pumped 8 hours twice a week, or even 8 hours once a week. Schedules and production are checked frequently with a view to changing schedules to meet changing conditions. A generally flexible program is followed.



One of the seven gas booster plants in the Salt Creek field

The Basic Gas-Turbine Plant And Some of Its Variants

*by J. Kenneth Salisbury**

This is the first of two parts of an article which presents a brief historical review of the gas-turbine plant, and a discussion of its operating characteristics and applications. The author touches briefly on thermodynamics, temperature, pressure relationships, the axial-flow compressor, regeneration, intercooling, reheat, and fuel economy. The second part of the article will appear in an early issue.

THE volume of recently published data concerning the constant pressure combustion-gas turbine has made most engineers reasonably familiar with its operating principle. It may be well, however, to discuss briefly the method by which power is produced. Fig. 1 illustrates diagrammatically the modern constant-pressure-combustion gas turbine which consists in its simplest form of a compressor, a combustion chamber, and a turbine.

The term "constant pressure" is used to distinguish the machine under discussion from the explosion gas turbine such as, for example, the Holzwarth type. It does not indicate that the pressure is constant for operation at all loads, but rather that a steady-flow process is used. The ratio of the maximum pressure in the cycle (at the compressor discharge or the turbine inlet) to the compressor-inlet pressure is designated as the "pressure ratio."

In the constant-pressure unit, atmospheric air is compressed in the compressor to several atmospheres pressure and then taken to a combustion chamber into which fuel is injected. The burning of fuel raises the temperature of the compressed air, which is then taken to the turbine in which it produces power, just as superheated steam produces power in a steam turbine. The greater part of the power produced (about two-thirds) is required to drive the compressor. Only the remainder is available for doing useful work.

*Turbine engineer, General Electric Co., Schenectady, N. Y. A paper presented before a meeting of the Oil and Gas Power Division, American Society of Mechanical Engineers, Tulsa, May 8-10.

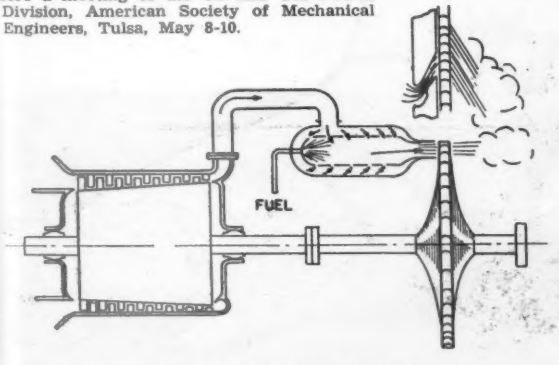


Fig. 1: Modern gas-turbine power plant

The history of the past two centuries is replete with records of the attempts of many people to find a satisfactory prim mover operating on combustion gases. It has been and still is probably the most frequently "invented" of all prime movers. The inventors range from English preachers to scientists of the highest type.

Many of the original inventions in the development of the combustion machine consisted of explosion engines, such as Huyghen's gun-powder engine of 1680, and Robert Street's turpentine explosion engine of 1794, which exploded vaporized turpentine by means of a firing aperture in the cylinder wall.

Beau de Rochas made an important contribution when, in 1856, he proposed the present Otto cycle, the cycle used in the modern automotive engine. The consummation of his proposal had to await the ingenuity of Otto and Langen, who built a free-piston engine in 1867, operated on Beau de Rochas' cycle. Meanwhile in 1860 Lenoir built the first commercially successful internal - combustion engine.

In 1895 Dr. Rudolph Diesel gave the world his diesel engine which today is a strong competitor in the prime-mover field.

In 1791, John Barber proposed the first important gas-turbine design. His plant was intended to operate on distilled coal, wood, or oil and, significantly, embodied a compressor driven by the turbine through chains and gears. In 1850, Fernihough obtained a patent on a producer-gas turbine. In 1884, Parsons described in his original patent an idea remarkably close to our present conception of the combustion gas turbine. Quoting from his patent he said that: "Such a fluid pressure producer (compressor) can be combined with a multiple motor (turbine) according to my invention to obtain motive power from fuel or combustible gas of any kind. For this purpose I employ the pressure producer to force air . . . into a furnace in which . . . may be introduced fuel. . . . From the furnace the products of combustion can be led . . . to the multiple motor which they actuate. The pressure producer and multiple motor can be mounted on the same shaft, the former to be driven by the latter. . . . In some cases I employ water or other fluid to cool the blades . . . to effect their protection."

In 1895, Charles G. Curtis obtained a U. S. patent on a gas turbine. In 1902 Dr. Sanford A. Moss operated a gas-turbine wheel at Cornell University. In 1904, the General Electric Co. operated gas turbines at both Lynn, Mass., and Schenectady. Thus this company has been interested in the gas turbine for 40 years. Dr. Moss was instrumental in the development of the centrifugal compressor and has continuously been interested in the gas - turbine - powered supercharger which is playing such an important part in the current war.

In 1907 Armengaud & Lemale reported 3 years' successful operation in Paris of a gas turbine. This unit used a Rateau "polycellular compressor" of the centrifugal type, having about 65 per cent efficiency and connected to a rebuilt steam turbine operating on combustion gases.

All of the early inventors encountered extreme difficulty in obtaining useful output from their machines. The reasons for this difficulty are today quite obvious.

Fortunately the output of the gas-turbine power plant increases very rapidly as the turbine initial temperature is increased, or as the compressor-inlet temperature is decreased. This fact is illustrated in Fig. 2 in which are shown progressively the effects of

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Then he said to himself—

"IMITATE IN GOOD THINGS"

THERE'S a sermon in the words of China's leader, Generalissimo Chiang Kai-Shek, as blue laws were clamped on his people's tendency to imitate our jitterbuggy way of life. Said he:

"CHINA IS FAR BEHIND THE WEST IN INDUSTRIALIZATION. WE WANT TO IMITATE THE WEST IN GOOD THINGS . . . WHY IN SUCH THINGS AS DANCING?"

Well he knows that example is contagious behavior. Well he knows that it is by imitation, far more than precept, that men can learn effectively and build on that knowledge.

Well he knows that his industrial men see, in the material coming from America, that recourse to ARCWELDING provides three basic GOOD THINGS for China's victory, for China's industrial effectiveness, for China's social advancement . . .

(a) faster production of more products

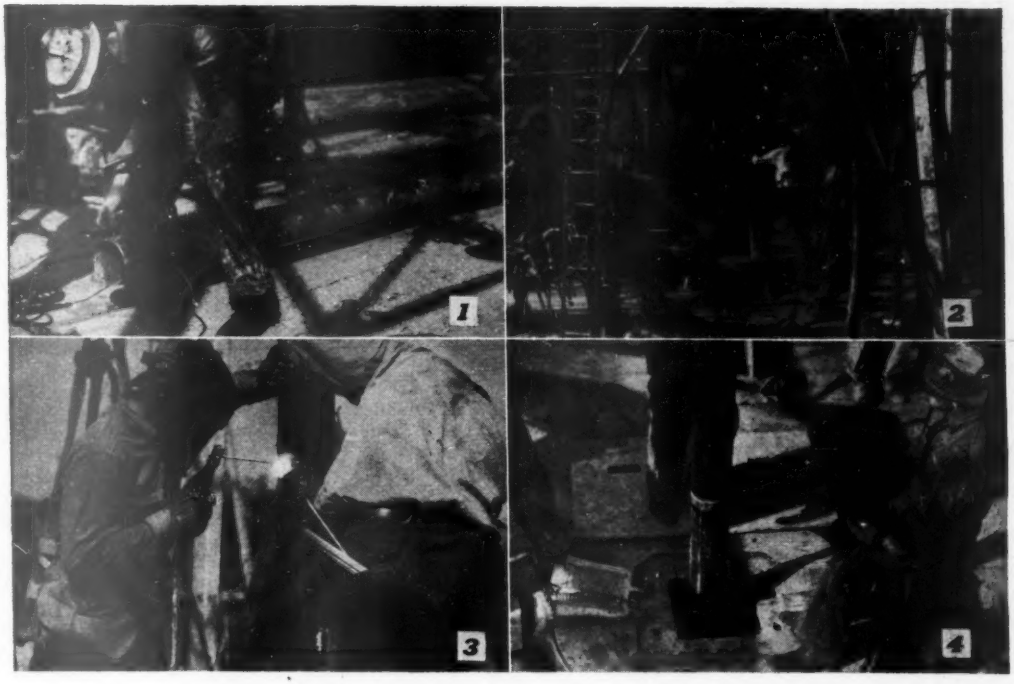
(b) more effective products

(c) for less money.

"Imitate in good things," he says

Here, Generalissimo, is a GOOD THING to

imitate in the field of oil production to run *better casing at lower cost:*



A GOOD THING FOR WELL CASING

Advantages of arc welded casing: (A) Plain end casing (no threading required) costs less. (B) Eliminates leakage. (C) Higher joint strength. (D) Smaller hole required for butt-welded joints. (E) Simplified recovery from abandoned holes.

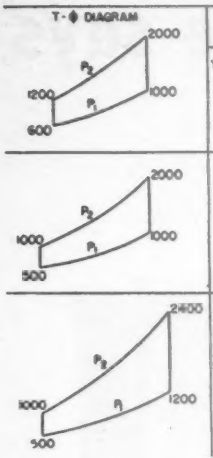
Procedure. See Page 1050-1054 *Procedure Handbook of Arc Welding.* Pictorially: (1) Applying lifting clamp. (2) Lined up by clamp, tack welding. (3) Welding (two passes). (4) Slips removed. Going down another 40 feet . . . Total time 3 minutes, 30 seconds.

THE LINCOLN ELECTRIC COMPANY • Cleveland 1, Ohio

America's greatest natural **recourse**

ARC WELDING

FOR CONSTANT FLOW POWER IS PROPORTIONAL TO TEMPERATURE CHANGE
(THEORETICAL BASIS IS 100% TURBINE AND COMPRESSOR EFFICIENCY
"ACTUAL" BASIS IS 80% TURBINE AND COMPRESSOR EFFICIENCY)



BASIS	TURBINE POWER		COMPRESSOR POWER		NET POWER	RATIO
THEORETICAL	1000	–	600	=	400	12½%
ACTUAL	800	–	750	=	50	
	GROSS/NET = 800/50 = (16)		MACHINERY/NET = 1550/50 = (31)			
THEORETICAL	1000	–	500	=	500	35%
ACTUAL	800	–	625	=	175	
	GROSS/NET = 800/175 = (4.6)		MACHINERY/NET = 1425/175 = (8.2)			
THEORETICAL	1200	–	500	=	700	48%
ACTUAL	960	–	625	=	335	
	GROSS/NET = 960/335 = (2.9)		MACHINERY/NET = 1585/335 = (4.7)			

Fig. 2: Effect of temperatures on output

1. Decreasing the compressor-inlet temperature, and

2. Increasing the turbine-inlet temperature.

Fig. 2 assumes, for convenience, that the flow and specific heat of the fluid have particular values such that the temperature change represents numerically the output in horsepower (the flow would be 10,600 lb. per hr. when using air). The temperatures chosen are arbitrary. The pressure ratio used is such that the adiabatic temperature ratio is exactly 2:1, a pressure ratio of about 11:1, when using air as a fluid. The outputs are shown on both a theoretical and an "actual" basis, the theoretical and actual bases being 100 and 80 per cent machine efficiency, respectively. The circled figures indicate clearly the rapid decrease in the ratio of the gross to the net turbine power, as well as in the machinery-power to net-power ratio. Note also that the ratio of actual to theoretical net power increases very rapidly as the turbine temperature is increased and compressor-inlet temperature is decreased.

Whereas the early experimenters were forced to use cycles having air rates higher than 200 lb. per hp.-hr., together with machinery which was consequently very bulky, the modern gas turbine, with its high-efficiency machinery and high initial temperatures, is able to operate at air rates of less than one quarter of this value. Thus progress is aerodynamic design and metallurgy, resulting in better efficiencies and higher throttle temperatures, has definitely brought the physical size of the gas turbine into the range of practicability.*

When designed for modern conditions of temperature and efficiency the gas-turbine power plant is extremely compact, light in weight, and approaches in efficiency some of the other modern prime movers. This compactness and simplicity is, in fact, one of its outstanding virtues. By contrast with the modern gas-turbine plant, Armengaud's gas turbine was physically very long but developed only 300 hp.

*The physical size of rotating machinery is largely determined by the volume flow which it must handle, especially when freedom is permitted in the choice of a rotational speed.

The Axial-Flow Compressor

The Rateau polycellular compressor clearly indicates that there was a real need for an efficient, compact, high-capacity compressor. One answer to this need is the axial-flow compressor; especially a "turbine" driven by external means, which increases the pressure of the fluid supplied to it rather than decreases it, as in the case of an ordinary steam turbine. It is interesting to note that the axial-flow compressor employs blade designs which are taken from the aeronautical engineering field. All of the information developed by aerodynamicists is available to the designer of axial-flow compressors. The Brown-Boveri Co. pioneered in the development of this modern kinetic-type compressor and has made many useful contributions to the design of such machines.

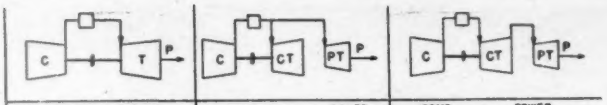
The axial-flow compressor is a comparatively new type of machine, hence many engineers are not entirely familiar with its method of operation. Velocity diagrams may be drawn for the axial-flow-compressor stage in much the same manner as they are drawn for a steam-turbine stage. The conventional airfoil section, when arranged in a grid similar to turbine nozzles, possesses the property of deflecting through a small angle the fluid which passes through it.

Entering the stator passages with a velocity W_1, the compressor blade causes a turning of the stream so that at the exit of the stator the velocity has the numerically smaller value W_2. The axial component is constant since the inlet and exit areas are approximately equal, but the whirl component is reduced from C_1 to C_2 by the action of the blade. The kinetic energy of the leaving stream is less than that of the entering stream, the reduction having been transformed by diffusion into potential, or pressure energy. The "whirl" or tangential component of the velocity entering the rotor is C_2 which, relative to the rotor, becomes V_1. The relative velocity entering the rotor is W'_2. The whirl velocity is again reduced in passing through the airfoil grid to V_2, giving a net total relative velocity W_1. The absolute velocity entering the following stator element is obtained by adding vectorially the wheel speed U, giving a value of W_1 identical with the original entering velocity. Diffusion has again taken place, in the rotor, resulting in a further increase in pressure. In essence the stator reduces the whirl component of the entering velocity and the rotor again restores this whirl component, thus consuming power and causing an increase in pressure.

The axial-flow compressor is essentially a constant-volume-flow device at any given speed. Increase in the discharge pressure causes only a slight reduction in the volume flow passed by the compressor. Eventually however, increase in the discharge pressure causes an excessively high "lift" of the airfoil sections and results in a sudden breaking down of their diffusing properties. At this time the compressor is likely to become unstable and destructive vibratory stresses may be set up.

The Turbine

There are several possible arrangements of the turbine in a combustion-gas-turbine power-plant, all of which are theoretically identical in thermal efficiency. Furthermore it is possible to use either a single or a multistage turbine of any type. The primary objective is both high plant efficiency and compactness. The author's company has chosen a single-stage turbine of the impulse type which, although admittedly somewhat lower in efficiency than a multistage turbine, has the compensating advantage of permitting higher initial turbine temperatures. The expansion through the turbine occurs in a single step and results in a rapid reduction of temperature before the hot gases come in contact with the buckets. The only parts which are subjected to the maximum temperature of 1,600° F. are those which are stationary and which have relatively low stresses. The most highly stressed part of the machine, namely, the wheel and buckets, is subjected to a reduced temperature when a single stage is used.



	COMP TURBINE / POWER TURBINE	COMP TURBINE / POWER TURBINE	COMP TURBINE / POWER TURBINE
THERMAL EFF'Y	18.6 %	18.6 %	18.6 %
OVERALL PR. RATIO	6:1	6:1	6:1
THROTTLE TEMP	1600°F	1600°F	1600°F
NET POWER OUTPUT	100	100	100
PRESSURE RATIO	6:1	6:1 / 6:1	3.18:1 / 1.89:1
TURBINE POWER	316	216 / 100	216 / 100
THROTTLE TEMP	1600°F	1600°F / 1600°F	1600°F / 1149°F
EXHAUST TEMP	940°F	940°F / 940°F	1149°F / 940°F
THROTTLE FLOW	100%	68.3% / 31.7%	100% / 100%
BUCKET TEMP	1100°F	1100°F / 1100°F	1275°F / 1000°F
COMMENTS	1. GOOD ACCELERATION 2. GOOD STARTING CHARACTERISTICS 3. INDEPENDENT SPEED-TEMPERATURE RELATION	1. POWER TURBINE SPEED INDEPENDENT OF COMPRESSOR SPEED 2 FREEDOM IN LOCATION OF POWER TURBINE 3. OPERATING TEMPERATURE FIXED BY EFFICIENCY OF UNITS	1 POWER TURBINE SPEED INDEPENDENT OF COMPRESSOR SPEED 2 FREEDOM IN LOCATION OF POWER TURBINE 3 OPERATING TEMPERATURE FIXED BY EFFICIENCY OF UNITS 4. EXCESSIVE BUCKET TEMPERATURE

Fig 3: Alternative turbine arrangements

Shown in Fig. 3 are three of the possible arrangements of turbine, all identical in thermal performance. The first indicates the arrangement least susceptible to the variables of temperature and machine efficiency. Reduction of temperature or machine efficiency results simply in reduction of the net output without prejudice to successful operation of the power plant. All of the excess power is available for acceleration of the plant when no load is applied at the output coupling. Starting problems are minimized and great simplicity results.

The parallel arrangement of turbine, in which a separate power turbine is employed, has as its chief advantage the complete freedom permitted in location and speed of the power turbine. In order that the compressor may use all of the power produced by the compressor turbine, a particular temperature is required at the compressor-turbine inlet for a given design pressure ratio. Subsequent decrease in machine efficiency would require increase in the turbine-inlet temperature to obtain balance. In addition, a conduit suitable for high temperatures is required to transport the hot gases to the power turbine unless, of course, a separate combustion chamber is utilized at the inlet to the power turbine, an entirely reasonable arrangement. Zero power output can be obtained by bypassing the power turbine through an equivalent restriction, whereas in the single-turbine arrangement, a reduction in temperature will accomplish the same result.

The series arrangement of the turbine requires a particular division of the pressure drop between the inlet and the final exhaust. The pressure drop is divided by means of proper design of the respective nozzle areas. Here again any change in the efficiency of the compressor turbine must be compensated for by change in the turbine temperature. The acceleration problem may be somewhat alleviated in certain instances by bypassing the exhaust gases to the atmosphere, thus momentarily increasing the power of the compressor turbine. Note that the bucket temperature for this arrangement becomes rather high even though a single-stage turbine is used.

A good conception of the single-shaft gas-turbine power plant arrangement is given in Fig. 4, which illustrates a design of a 3,000-hp. marine gas-turbine power plant having a single compressor and turbine unit. The multiple combustion chambers are arranged in juxtaposition to the turbine wheel itself, thus minimizing problems in transport of the high-temperature gases. Air enters the compressor at the left-hand side and, after compression, is passed through the rectangular ducts, past the exhaust hood, and into the annular space surrounding the inner liner of the combustion chambers. The latter are mounted at the end of the unit for easy accessibility in replacement if this becomes necessary. The relatively cool incoming air causes the liner to operate at a temperature considerably lower than the gas temperature. The hot gases pass immediately through an air-cooled nozzle and to the turbine buckets, thence through the exhaust hood to the atmosphere.

Operating Characteristics

For illustrative purposes, the basis of nearly all of the calculated data is a nominal turbine and compressor efficiency of 80 per cent. Small variations of the efficiencies will not seriously affect the relationship of the characteristic curves in the comparison of various cycles. In most cases the cycle pressure drops have been neglected. Since pressure drop is exchangeable for compressor or turbine efficiency the fuel-consumption data presented herein would require higher efficiencies than 80 per cent in accordance with the magnitude of the cycle pressure drops. For an actual design it is, of course, essential that the minor variations, such as variable specific heat, reheat factor, presence of a small quantity of fuel, pressure drops, etc., be properly taken into account in order that the output of the machine will be as predicted. This is true to a greater extent for the gas-turbine plant than for a steam plant because of the "leverage" resulting from the large ratio of machinery-power to net-power, and the comparatively short energy range which is used.

Fig. 5 shows the manner in which the net output at the coupling varies as the pressure ratio (hence speed) varies, for various initial temperatures. Note the rapid decrease in power as the inlet temperature is decreased. The variation in power is approximately linear with respect to pressure ratio over part of the range. In an actual gas-turbine plant, it is desirable to reduce the temperature as the speed (pressure ratio) is reduced in order that excessive bucket temperatures will not be encountered.

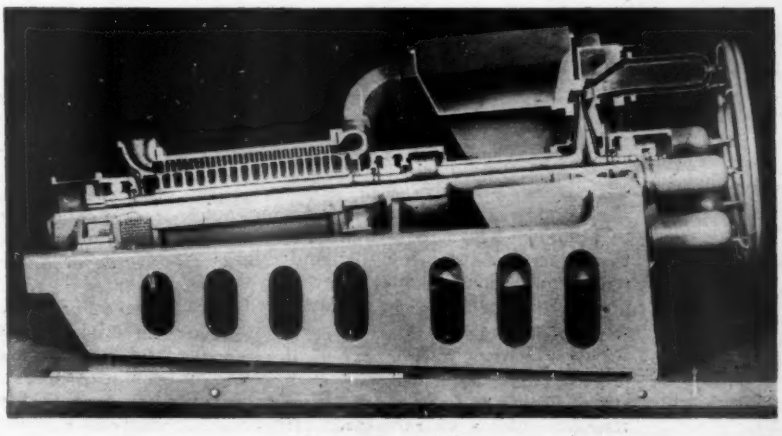
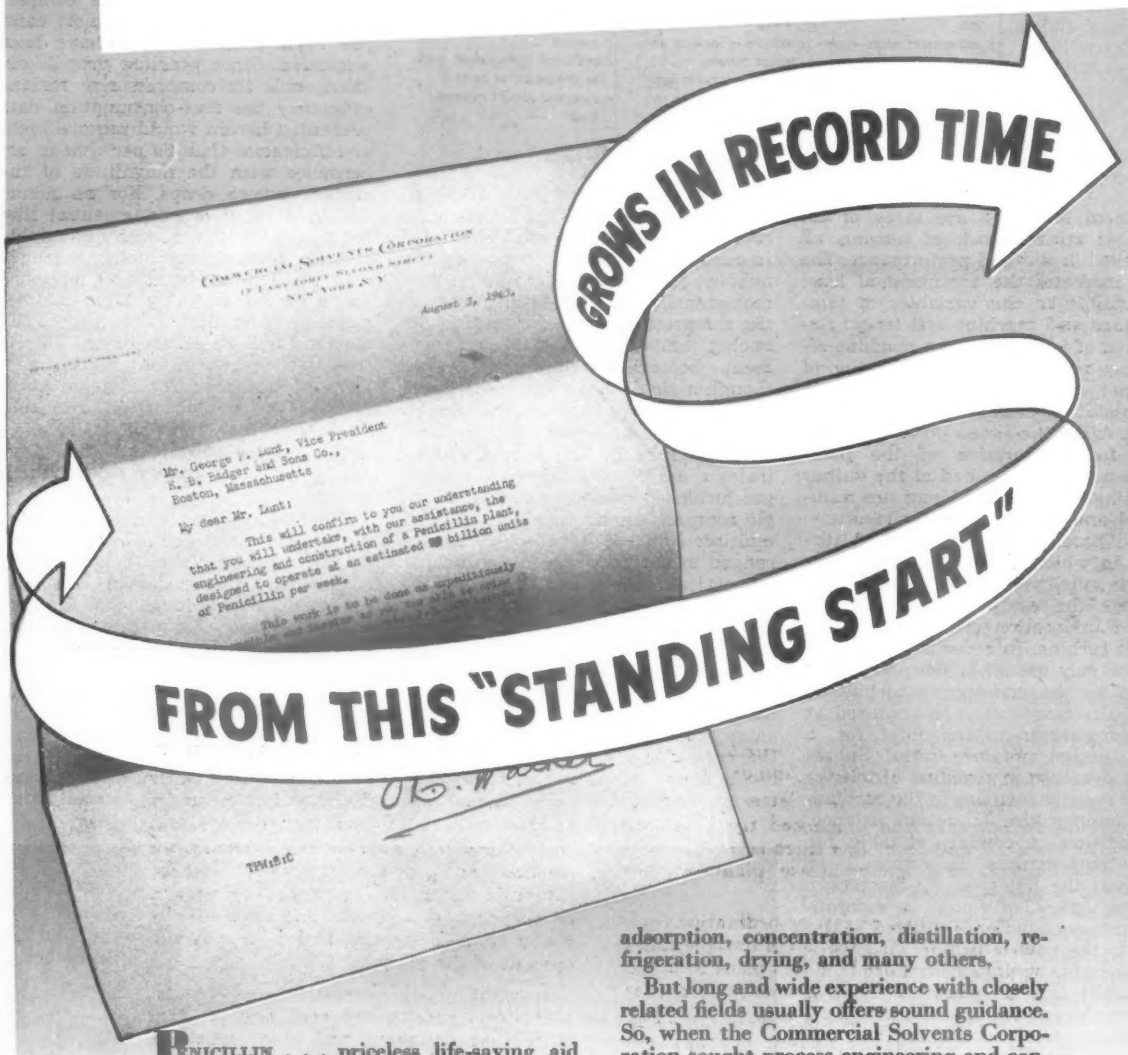


Fig. 4: Cross-section of a marine-unit model of gas-turbine plant

WORLD'S LARGEST

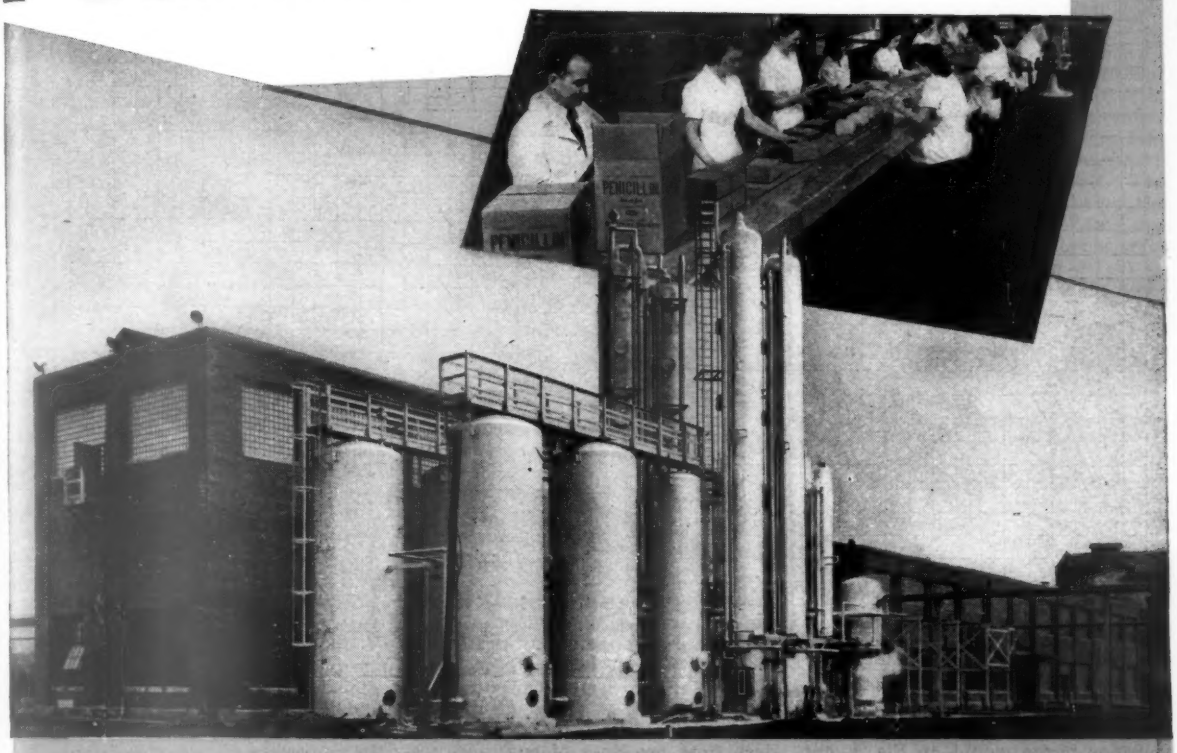

GROWS IN RECORD TIME
FROM THIS "STANDING START"
COMMERCIAL SOLVENTS CORPORATION
August 3, 1943.
Mr. George P. Lunt, Vice President
E. B. Badger and Sons Co.,
Boston, Massachusetts
My dear Mr. Lunt:
This will confirm to you our understanding
that you will undertake, with our assistance, the
engineering and construction of a Penicillin plant,
designed to operate at an estimated ■ billion units
of Penicillin per week.
This work is to be done as expeditiously

PENICILLIN . . . priceless life-saving aid to humanity! So new is this wonder drug that when war-emergency demanded large-scale production quickly, there was little precedent on which to base manufacturing requirements.

Never before in our experience were process engineers faced with such a variety of problems to be solved in so short a time—problems of extraction, filtration, adsorption, concentration, distillation, refrigeration, drying, and many others.

But long and wide experience with closely related fields usually offers sound guidance. So, when the Commercial Solvents Corporation sought process engineering and construction services for a plant "*designed to operate at an estimated* (censored) *billion units of Penicillin per week,*" to be completed "*as expeditiously as possible,*" it was the highly qualified Badger organization that was selected to handle the entire project in co-operation with the Research and Engineering Departments of Commercial Solvents Corporation.

PENICILLIN PLANT



This was the first large Penicillin plant to go into initial operation (January 31, 1944).

August 3, 1943 (see letter reproduced on opposite page), marked the "standing start," and from this there rose *WITHIN 180 DAYS* the complete plant you see pictured above!

Only through perfect co-ordination could the design and fabrication of the specialized equipment required for this plant be scheduled to meet so short a construction time.

Because Penicillin is a sensitive product, and its efficacy is dependent on many critical factors of production, this achievement, for speed and intricate details, completely overshadows the work of average chemical-plant designing and construction.

Among the hundreds of requisites, Badger provided equipment for manufacture under extreme sterility; for vacuum dehydration to 1/10,000th of atmospheric pressure; for constant refrigeration to prevent deterioration during manufacture, packaging, and on through to shipment; and even for the rabbit farm for testing and further development of the product.

It is the sum of diversified and cumulative experience in process engineering, equipment designing and plant construction that enables Badger to handle new and unusual projects of any size, anywhere in the world.

E. B. Badger & SONS CO., BOSTON—EST. 1841

NEW YORK • PHILADELPHIA • SAN FRANCISCO • LONDON

Process Engineers and Constructors for the Chemical, Petroleum and Petro-Chemical Industries

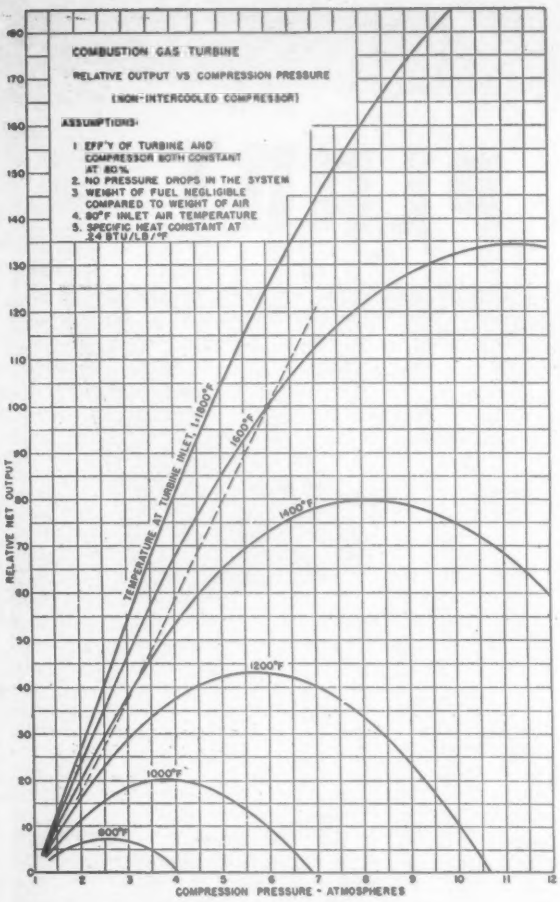


Fig. 5: Net output as a function of operating pressure

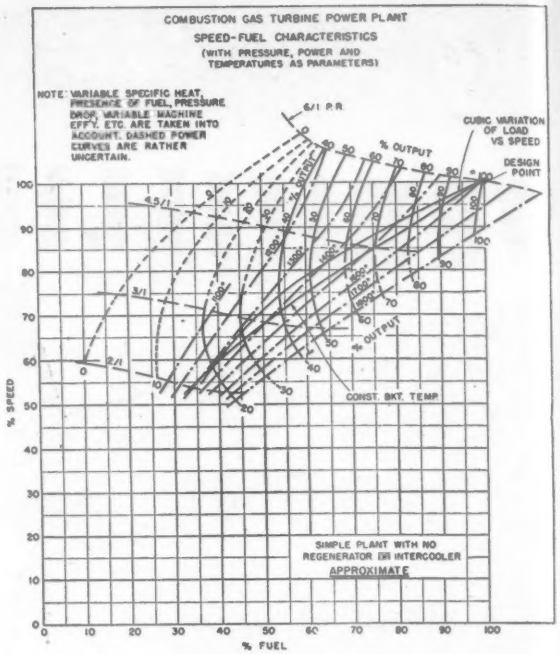

COMBUSTION GAS TURBINE POWER PLANT
SPEED-FUEL CHARACTERISTICS
(WITH PRESSURE, POWER AND TEMPERATURES AS PARAMETERS)
NOTE: VARIABLE SPECIFIC HEAT, PRESENCE OF FUEL, PRESSURE DROP, VARIABLE MACHINE EFFY, ETC. ARE TAKEN INTO ACCOUNT. DASHED POWER CURVES ARE RATHER UNCERTAIN.
6/1 P.R.
CUBIC VARIATION OF LOAD VS SPEED
DESIGN POINT
% OUTPUT
CONST. BKT. TEMP.
SIMPLE PLANT WITH NO REGENERATOR OR INTERCOOLER
APPROXIMATE
% SPEED
% FUEL

Fig. 6: Characteristics of the gas-turbine power plant

This reduction in speed also improves the thermal performance. The actual operation curve would, in Fig. 5, cut across the various temperature lines as the pressure ratio is decreased, in the manner indicated by the dash line.

Many variables are involved in the study of the gas-turbine power plant. Oddly enough, this simplest of all power plants offers so many alternative methods of operation that a clear conception of the interrelationship of all of the variables is rather difficult to obtain.

The gas-turbine power plant in operation can be affected externally only by change of the fuel supplied or of the speed. The former can be controlled automatically or otherwise through a fuel pump or throttle valve, while the latter is controlled by the character of the load applied to the gas-turbine coupling. These two variables, that is, speed and fuel, therefore represent the most logical ones against which to illustrate the characteristics of the power plant.

In Fig. 6 are pictured the more important characteristics plotted with parameters on a speed-fuel plane. The data take into account all of the minor variables, such as variable specific heat for the true gas composition, pressure drops, weight flow of fuel, variable machine efficiency, etc. The nearly vertical curved lines in Fig. 6 are lines of constant-output. The dash-dot lines are lines of constant turbine inlet temperature, and the dash lines are lines of constant-pressure ratio.

Given Power Output

Note that a given power output can be obtained at several combinations of conditions; for example, 100 per cent output can be obtained with either 6:1 pressure ratio and 1,600° F. inlet temperature, or with about 5:1 pressure ratio and about 1,800° F. temperature. If the latter combination is used, the fuel consumed is about 97.5 per cent of the design fuel consumption, and the speed is approximately 88 per cent of the design speed. It will be noted that a unit operating at 50 per cent power and at 100 per cent design speed consumes more fuel than the same unit would consume if its speed were reduced to about 80 per cent of the design speed. Thus, there is a sacrifice in economy when the gas-turbine unit is operated at constant speed and reduced load. The locus of the conditions of operation for best fuel economy is a line passing through the points at the extreme left on the constant-power curves. Such a locus corresponds very nearly to the line which represents operation at constant bucket temperature.

Study of these data indicates the particularly favorable relationship between the power-speed characteristic of the gas turbine for best fuel economy, and that encountered in marine applications. As the power is reduced, a reduction in speed is required if best fuel economy is to be obtained. This reduction in speed is very nearly equal to the natural reduction in speed which accompanies reduction in power for a propeller-driven ship. Obviously, in any application where fuel economy is important, some provision should be made for reduction in the compressor-set speed as the load is reduced.

Frank E. Nelson, employed in Humble Oil & Refining Co.'s production department, in the Avoca district, Jones County, Texas, has been promoted to assistant district superintendent. **William A. Watson,** assistant district superintendent, has been transferred from the Sand Hills district, Crane, Tex., to the Hurdle district, McCamey, Tex. **Carl S. Ham** was promoted to assistant district superintendent of the Pyote district, Wink, Tex.

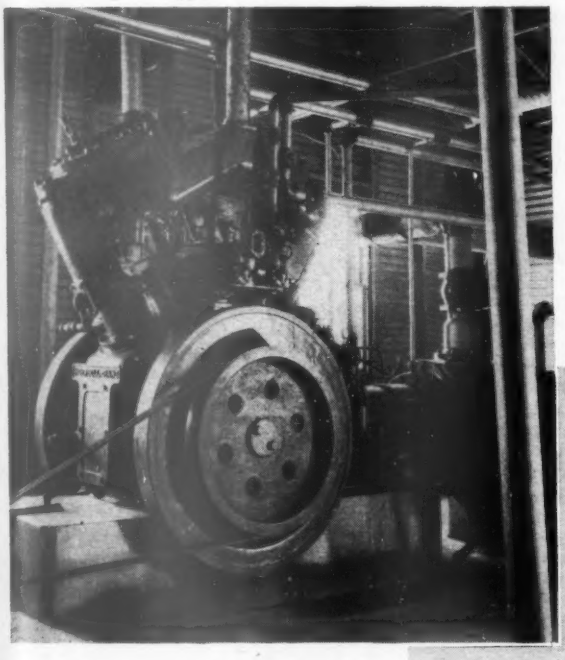
E. W. Chase was elected chairman of the board and vice president of Wolf's Head Oil Refining Co. at the annual meeting of directors. **A. W. Scott** was chosen president and secretary; **J. B. Mitchell,** vice president; **E. E. Bellen,** treasurer; **W. J. Hogan,** assistant secretary.

Rotation-Type Gas-Lift System

by E. H. Short, Jr.

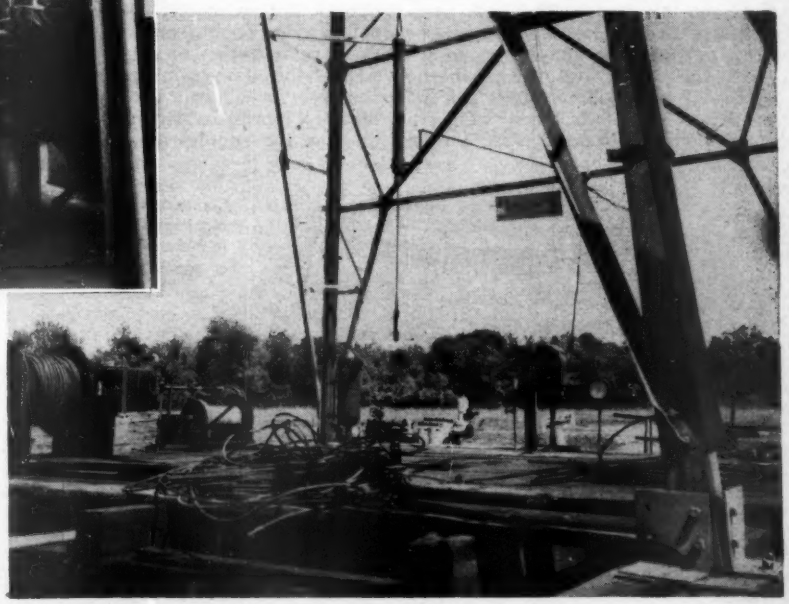
In a previous issue of The Oil and Gas Journal (January 17, 1944, p. 49), a method of gas lift employed to produce deep Gulf Coast wells and involving the use of high-pressure gas, available either from the same lease or other sources, was described. This article concerns another method being adopted in a number of Gulf Coast fields where high-pressure gas is not available. This method, designated as the "rotation" system, makes use of a small compressor and alternate operation of wells.

THE "rotation" type of gas-lift system is being employed in a number of production operations on the Gulf Coast. This type of gas lift involves the use of a small compressor plant with well input and output lines representing a closed system. Gas is compressed, injected into the annular space between tubing and casing, admitted into the lower end of the tubing intermittently, ejects the accumulated fluid up through the tubing, thence to the central separator. The gas from the separator, under 15 or 20 lb. pressure, then is taken back into the intake of the compressors, thus making a complete round. This method of lift differs in a number of respects from the compressed-gas method of gas lift extensively used in various fields (notably Seminole) during past years.



Left: One of two small compressor units in Mackhank Petroleum Co.'s rotation gas lift plant at Boling, Tex.

Below: Individual well hook-up showing surface intermitter and recording gage in background, and weight cylinder, which raises and lowers weight bar, in foreground



Except for a few experimental installations, all Seminole wells, for example, were produced on straight flow, whereby the gas was injected down the tubing and flow established in the annular space between tubing and casing. Under the gas-rotation system, the wells are produced by means of surface-controlled intermitters.

The subsurface equipment consists of a string of tubing, surface-controlled valves, a control-head-type packer, and a wire line equipped with a weight bar. The surface-controlled valves are inserted into the tubing string as it is run, and the number of valves used depends upon two factors, the fluid level and the maximum pressure available for kickoff. The packer is run on the tubing below the lowest valve, and also, depending upon the fluid level and the capacity of the well, the packer may be set at any point in the casing. Usually, however, it is set in the casing as close to bottom as possible. The only other subsurface equipment used is a wire line which extends (inside the tubing) from the surface to the lowest valve. A long round weight bar is attached to the lower end of the wire line, and the valves may be opened by a gas-operated piston at the surface, which pulls the wire line. This operation, the interval of which is controlled by an intermitter located at the well, causes the weight bar to move up into the valve which opens it and permits gas from the annular space to expel the fluid accumulated during the "off" period.

In a large number of Gulf Coast wells the bottom-hole pressure is great enough so that it is possible to hold some separator pressure on gas-lift wells without a reduction in the

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amount of fluid lifted. However, the fact that packers are set and intermittent flow employed in the gas-rotation system permits separator pressure to be held on low bottom-hole-pressure wells without any effect on the amount of fluid lifted. This ability to hold pressure on the separator without loss or reduction in a well's production has a favorable economic effect upon this particular method of gas lift. For example, a pressure on the separator which will permit a 15-lb. intake pressure on the compressors will cut in half the compressing equipment which would otherwise be necessary if gas were being compressed at atmospheric intake pressure.

$$\frac{15 \text{ lb.} + 14.7 \text{ lb.}}{14.7} = 2.02$$

One of the older gas-rotation plants on the Gulf Coast is operated by Mackhank Petroleum Co. in the Boling field, Wharton County, Texas. This is one of the plants whose successful operation has been largely responsible for the comparatively recent installations of gas-rotation systems of gas lift in the Hitchcock, Dickerson, Barbers Hill, Aransas Pass and Golden Meadow fields.

Mackhank Petroleum Co.'s lease is on the west flank of the Boling structure, and at one time nine wells were operated from a compressor plant consisting of only two small units. Currently, five wells are being operated with a total fluid production of 2,297 bbl. per day. Depth of the wells varies between 4,000 and 6,500 ft. The length of the tubing strings ranges from 3,500 ft. to 5,500 ft. Each string of tubing is equipped with from 6 to 10 surface-controlled flow valves.

The rotation system used on this lease is shown in the accompanying diagrammatic sketch. The high-pressure gas lines from the compressor plant, and also the annular space between the casing and tubing in the wells acts as a volume tank. The intermitters located at each well are timed so that only one well at a time in the system is on flow. The necessity for this is obvious, since if a large amount of gas hit the central separator from two wells some of it might be lost through the separator vent line.

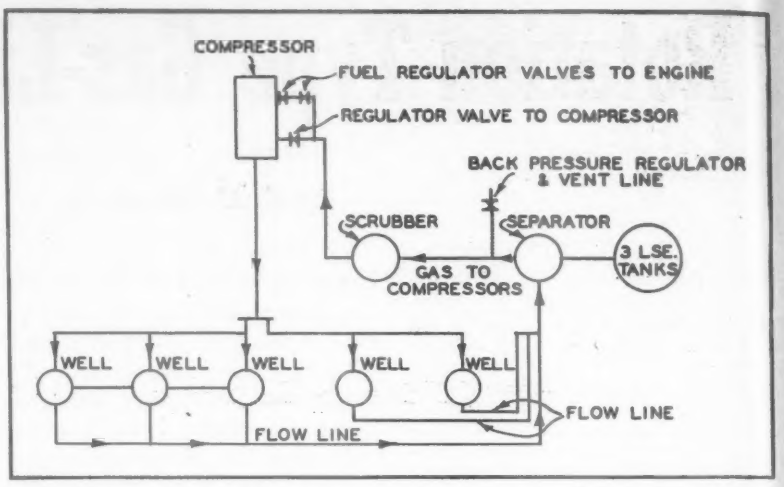

Diagram of Mackhank Petroleum Co.'s rotation gas lift system in Boling field

An example of the small initial investment required for a plant of this kind is apparent when it is considered that only two compressors were originally installed in the Mackhank plant. One unit is a 9 by 4½ by 10-in. Chicago Pneumatic compressor, directly connected to an 80-hp. vertical-type engine, and a 12 by 5½ by 12-in. Ingersoll-Rand compressor, directly connected to a 75-hp. V-type engine.

A pressure of approximately 30 lb. is held on the central separator, and this is reduced to hold a 15-lb. pressure on the intake of the units. With this intake pressure the plant has a capacity of approximately 1,500,000 cu. ft. of gas daily at a discharge pressure of approximately 500 lb. An accompanying photograph shows the California type scrubber through which the gas from the separator passes before it goes into the intake of the compressors. Gas for the operation of the engines is also taken on the plant side of the scrubber, and the engine volume tank and regulator is shown at the entrance to the building.

Production from the wells being gas lifted on the Mackhank lease varies from as low as 38 bbl. of oil with 9 bbl. water to a maximum fluid production of 700 bbl. per day, only 15 of which is oil. The amount of gas currently required to lift a barrel of fluid amounts to only 350 cu. ft. Figures on the operation of similar plants show that the average cost of compression is about 2 cents per 1,000 cu. ft. This figure is based on a 10-year payout, and includes maintenance and labor.

Compressor plant for Mackhank gas lift system. In foreground is portion of scrubber

BOOKS

CONTROL OF ELECTRIC MOTORS. By P. B. Harwood; 2nd ed.; John Wiley & Sons, Inc.; 479 pp., $5.

This volume describes briefly the characteristics of various types of motors, and explains how the characteristics are used for control purposes. The design, construction and operating characteristics of a number of controllers and control devices are discussed, and methods of combining these devices to secure a desired result are described. Problems frequently encountered, such as motor acceleration, dynamic braking, and resistor design, are treated in detail. A chapter on synchronous motor control, and a chapter on variable-voltage control have been added to the second edition, and many new tables giving the ratings of motors and controllers have been included.

John P. Klep, engineer and Texas manager for Sperry-Sun Well Surveying Co. when he entered the Air Service Command as a lieutenant in the fall of 1942, is now overseas and recently was promoted from captain to major.

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Transmission Line Experience In Appalachian Region

by J. A Clark and G. W. McKinley†*

In this article the authors describe how an enormously heavier load on a pipe-line system has been taken care of without making any material changes. It has been necessary to sharply increase the efficiency of existing lines and compressing stations. With the changes that have been made, the engineers feel that the system's capacity has been increased enough to take care of any additional demands that are likely to be made.

IN the past 4 years the load on the pipe-line system of the Consolidated Natural Gas Co. has increased about 50 per cent compared to the average normal load of the preceding 20 years and to meet this heavy increase every possible improvement in operating conditions has been called for, without, however, making any major changes which the material situation has made impractical. Since major additions were out of the question the only alternative was to increase the efficiency of existing lines and compressing stations and every effort in the past 4 years has been directed toward this end.

Our first thought was the use of pipe-line scrapers to remove dirt and polish the inside of the pipe wall, which has been done extensively in the southwest. We found that due to the large number of bends in our lines, caused by the rough country traversed, and the methods previously used for bending pipe it was impossible to run scrapers through our system and the idea was abandoned.

Our next thought was that our experience with dehydrating the gas had been so successful that this should be carried farther. Our first plant was installed at our Cornwell Station in 1936 using calcium chloride and ammonia refrigeration. This plant has accomplished everything for which it was designed and the line efficiency in 8 years' use has shown no decline at all and is still around 91 per cent of the flow by Benj. Miller's formula for perfect pipe. The second plant we installed was a 200,000,000 cu. ft. per day Glycol plant at our Hastings station to dry up the discharge lines north of that point. This plant has operated for 4 years now with so little trouble that we rarely think of it, but for the 4 years previous to 1939 the average peak day efficiency of all the lines north of Hastings was 71 per cent, while the efficiency of the same lines the past 4 years has averaged 87 per cent, or an improvement of about 16 per cent in flow capacity. With these results in mind a complete check of all our major lines was begun, with the idea of locating all low spots where fluid was apt to accumulate. We were greatly helped in this work by an improvised model of the familiar doctor's stethoscope, adapted to pipeline work, with which it was possible to locate pockets of water very closely. After all these low spots were located the installation of new drips and much closer patrolling has materially improved the general system efficiency.

*Chief engineer and †division engineer, Hope Natural Gas Co. A paper delivered before the Natural Gas Conference of the American Gas Association, French Lick, Ind., May 11-13.

High-Pressure Transmission

The next possible method of improving capacity was the greater use of high-pressure transmission. Studies made by Hope, and confirmed by the published results of other companies, have convinced us that for volumes less than 100,000,000 cu. ft. daily the most efficient design is to use small lines and the highest possible operating pressure. Between 100,000,000 cu. ft. and 150,000,000 cu. ft. is a debatable zone, but after passing volumes of 150,000,000 cu. ft. daily the large-diameter pipe line using the thinnest wall practical is the most efficient design. The Hope system has two major centers, one at Cornwell in the southern part of the state where approximately 50 per cent of our supply of gas comes in and the other one 100 miles north at Hastings where 75 per cent of the sales are made. Between these two points there is a network of large medium-pressure lines, to which Hope added, in 1936, a new 12¾-in. high-pressure line with ⅜-in. thick walls of seamless pipe, designed for 1,350 lb. working pressure. This line has been described before this association previously and considerable test work has been done on it so that we were quite sure of the possibilities in its full use. Up until 1941 we had operated this line with about 50,000,000 cu. ft. a day flow and an inlet pressure of about 750 lb., but in that year we added 1,000 hp., increased the capacity of the dehydration plant, and raised the flow to 75,000,000 cu. ft. daily with a pressure at Cornwell of 1,000 lb. After 8-year experience with this line, we have had literally no repair or maintenance expense and it has been a very satisfactory installation.

With this experience and the fact that we expect to receive at the end of this year a large volume of gas from Texas through a new pipe line, coming into Cornwell, this year's work has followed the two approaches mentioned before. To further increase the capacity of Cornwell we are now installing an additional 1,000 hp. and intend to raise the pressure on the 12¾-in. line to 1,350 lb. and to increase its carrying capacity to 100,000,000 cu. ft. daily. The new gas coming in from Texas will be dehydrated to a dewpoint of about 25° F. at 700-lb. gage and by putting about half of this through the present dehydration plant and dehydrating to a dewpoint of about 0° F., we expect to bring the dewpoint of the entire volume in the line down to 30° F. at 1,350 lb.

In connection with the design of this addition at the station we have followed our previous practice of using the specifications of Section 2, Division 1 of 1942 Code for Pressure Piping. Apparently, according to the code, it would be permissible to use the specifications of Division 2 for cross-country pipe lines, for the design of piping around the compressing stations. However, we have felt that due to higher temperatures and vibration encountered from the operation of multiple compressor cylinders, it was much better design to use the specifications of Division 1, until the pipe line had left the station grounds. This is very similar to our previous practice before publication of the code.

Glycol Dehydration Plants

To increase the efficiency of the lines between Cornwell and Hastings we are building two 75,000,000-cu. ft. capacity glycol dehydration plants. One of these plants will be located at Cornwell and the other one at a large underground storage pool where it will dry up the gas going into storage during the summer, and will also be used to dry gas coming from the pool into the pipe lines during the winter period. By these means we hope to materially increase the carrying capacity of the lines between these two points.

To relieve growing shortages due to the decline of the fields in northern Pennsylvania and western New York the Hope has asked permission to lay a new line into this area this summer. This line has been designed

3,000 kw package type surface condenser

DESIGNED AND BUILT BY LUMMUS FOR INTERNATIONAL GENERAL ELECTRIC CO.

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Among the interesting features of design and construction are . . . tube sheets welded to the shell of the condenser, eliminating two packed joints (sources of possible air leakage) . . . complete deaeration of condensate in the hot well through the introduction of exhaust steam in the deaerating system . . . air ejector set, designed and built by Lummus is an integral part of the package unit.

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for 50,000,000 cu. ft. but may some day be increased as the fields in this northern area continue to decline. This line is approximately 145 miles long and has been designed with the experience obtained from our other high-pressure line built 8 years ago. It will be 12¾-in. o.d. but due to the improved methods of manufacture and the higher elastic limit of pipe as made today, much thinner walls can now be used for the same pressures. We feel that the code allowance of 72 per cent of the elastic limit as a working stress is perfectly practical and safe, so we contemplate laying a line 9/32 in. thick. This line at first will be operated at about 750 lb. but later as the demand increases will be safe for 1,300-lb. operating pressure. However in the compressing station yard we are using pipe with a yield point of around 35,000 lb. and much heavier walls meeting Division 1 specifications.

With these changes we feel that we will have increased the capacity of our system to take care of any additional demands likely to be made upon it, and have accomplished this at a comparatively low cost for the results obtained.

Compressor-Station Design for Long-Distance Natural-Gas Transmission Systems

*by M. C. Madsen**

Here is a detailed outline of the factors that should be considered in designing a compressor station for a gas pipe-line system, ranging from the location of the site to dwellings for employes. The author treats briefly the chief items of equipment, and predicts a new form of compressor unit that will replace the old standbys of today.

CERTAIN fundamental considerations are present in the design of compressor stations for any gas pipeline system, existing or contemplated. These include station location in respect to highway facilities, proximity to communities, schools, an ample supply of satisfactory water, topography and soil conditions. It is not always possible to choose a location which would be ideal from every point of view but it is important that as many of these factors be present as conditions will permit.

It is highly desirable that good roads serve the station from adjacent communities. Customarily a portion of the operating personnel resides in communities near the station and good roads allow for minimum absenteeism during unfavorable weather. Such roads also minimize difficulties and expense in the transportation of materials and supplies between the station and rail point.

An ample supply of good water for plant and domestic use is of paramount importance. A reliable water-development company should be engaged to drill test holes on the site or nearby for determining a suitable water supply source. Better water may sometimes be discovered a few miles from the station and in such cases the wells should be so located. As a rule, relatively shallow gravel-wall wells provide better water than deep wells producing from below rock formations. Sand and gravel beds adjacent to flowing streams are excellent sources of good water. Water supplies secured from running streams or from artificial ponds usually are not satisfactory. In any case it is necessary that an analysis of the water for station use be determined promptly in order that the proper type of treating equipment may be selected.

It is desirable that the station be within easy reach of a community. The operating personnel housed on the station site have many problems which should be understood and alleviated whenever possible. Proper attention to these matters will pay dividends in contented operators. The school situation should be investigated and transportation of children to and from school is a matter that should be solved. Communities, even though small, usually provide sufficient diversion to satisfy the majority of operators' families.

Topography is important and the station should be so situated as to allow for good drainage. Overflow land should be entirely avoided.

Soil conditions should be investigated to allow for proper design of foundations. Rock formations are not objectionable except from the standpoint of construction costs. Soft formations such as oozy clay, peat and quicksand should be avoided. Any stable formation which will support 2 tons per sq. ft. is satisfactory as a station site.

Main Engines

There has been a strong tendency toward the use of multicylinder vertical engine during recent years, and especially since the outbreak of World War 2. The number of stations employing slow-speed horizontal engines is so large, however, that the discussion which follows will deal with this type only. In passing it may be said that the cost per installed horsepower for the vertical units is considerably less than that for the horizontals, but on the other hand, continuous performance, maintenance and operating costs are in favor of horizontals over verticals. In the long run, perhaps, there would be little to choose between the two types of engines.

Main Engine Foundations

It is desirable to construct engine foundations on a continuous reinforced concrete mat which at the same time serves as basement floor and support for building foundation walls and columns. Engine foundations should be adequately doweled to the mat to prevent separation, and adequately reinforced to prevent cracking due to unusual operating stresses. Cracked foundations may be traced to inadequate reinforcement and to stresses imposed when normal "engine stretch" was arrested by seizure of distance pieces or tail guides on the subbases or sole plates. Such damage is apt to be more prevalent and serious in stations where a mat is not provided. The mat further serves to prevent settlement of foundations and subsequent misalignment which may lead to operating difficulties.

Main Engine Exhausts

The air-cooled exhaust has largely replaced the water-cooled type in recent years. The outmoded wet exhaust has some good features, but the undesirable points of this type are such that good, modern design should exclude its use. Elevated operating-floor construction allows for exhaust installations to be entirely above the ground which makes for ease in operation and minimum maintenance cost. Air-cooled exhausts permit the installation of heat economizer ducts and blowers, by which means the

*Chief engineer, Northern Natural Gas Co. A paper delivered before the Natural Gas Conference of the American Gas Association, French Lick, Ind., May 11-13.

main building may normally be adequately heated by utilizing waste exhaust heat and requiring but a small amount of assistance from a heating boiler.

Engine Cooling

Engine performance is improved and maintenance costs lowered by maintaining a fairly high inlet water temperature to the jackets. Proper attention to circulating water pump and piping arrangements will permit for a fairly uniform inlet water temperature condition throughout the year. This is accomplished by tempering the cooled water supply to the engines with the proper amount of warm water from the engines to obtain the temperature desired.

Oil Filters

Proper conditioning of lubricating oil circulated through the engine bearings is a matter requiring very careful attention if clean oil and low oil consumption are to be realized. Pressure filters of the bag type or metal disk type are well suited for primary oil filtering but are limited to partial oil cleaning. Final clarification can be obtained through the use of a pressure filter fitted with a cotton-waste core installed on a bypass connection on the oil discharge line from the primary filters. The quantity of oil bypassed through the final filter should not be large enough to affect proper engine lubrication. Clean oil from the final, or bypass, filter is returned by gravity to the engine-oil supply tank. The cotton-waste core of the bypass filter is discarded and renewed when the pressure drop across the filter, or color of the oil, indicates that replacement is necessary.

Combustion Air Filters

Filtration of combustion air is important in sections of the country subject to dust or sand storms. Two types are in general use, the oil impingement and the water spray. In selecting air filters, those of the constant pressure-drop type should be chosen, in that the variable-drop types greatly disturb engine performance and increase fuel consumption. Furthermore, they require much more attention on the part of the operators and are otherwise objectionable.

Gas-Engine-Driven Generators

It is of primary importance to provide a station with an uninterrupted supply of electric power. Seldom is it possible to purchase such power and if it is available, too often it is risky to rely on it for the continuous service that a main-line station demands. Generators of ample capacity, with allowance for station expansion, should be installed, along with an extra unit for standby service. The generators should be direct connected to multicylinder vertical gas engines, the power of which should be ample to prevent crowding of maximum rating. Engines of this type perform best when not too fully loaded, and some elbow room will pay dividends in reduced maintenance expense. Generator voltage is a matter of economics for any given situation but usually 440 volts or less is satisfactory for the average station. Lube-oil bypass filters should be installed on the engines, also combustion air filters if the station is situated where dirty air is encountered. All auxiliary equipment, except for an emergency air compressor, should be electrically driven.

Starting Air Compressors—Air Storage

Large horizontal main engines require high-pressure air for starting purposes and this is provided by two-stage compressors capable of delivering air at 250 lb. pressure. Two motor-driven machines are usually installed, one ordinarily being used for standby, but both being operated occasionally when a large volume of air is needed quickly. It is recommended that a small gas-engine-driven air compressor be installed for emergency use, in starting up a station for the first time, or after a period of idleness during which the stored air supply may be dissipated.

Two air receivers, approximately 4 ft. by 20 ft. should be installed and air at 250 lb. per sq. in. maintained in them. It is customary to use air from one tank while filling the other. Air receivers should be carefully protected against corrosion, especially on all inside surfaces. They should be sloped slightly to one end to allow for drainage of water and oil accumulations and receiver drains should be arranged in a manner that will prevent freezing.

Water-Circulating Pumps

Two sets of centrifugal pumps are provided for the station. One set circulates cooled water to the engines and the second picks up warm water from the engines and delivers it over the cooling tower. These pumps may be installed in at least three different places, viz., in a pit in the auxiliary building, in the main building basement or in a combination cold and hot well which allows for a compact, easily controlled arrangement of pumps which are of the vertical, sump type, inserted through the concrete slab top of a combination cold and hot well, with motors and controls at ground level. As previously mentioned, the arrangement should provide for mixing hot water with the cold water picked up by the cold pumps in order to obtain the temperature desired for main engine supply. The motors and controls should be protected by a small building, built over the combination cold and hot well.

Fire Pump

A motor-driven centrifugal pump should be installed for fire protection in the cottage area. Water pressure in the plant circulating system usually is much too low for fire-fighting purposes. This pump should be large enough to allow for two standard hose streams to play on a fire, with 50 to 60 lb. pressure at the nozzles.

Battery Chargers

The large horizontal main engines are operated with wet-cell batteries which are suitably arranged in the auxiliary building. These batteries are kept charged by means of motor-generator sets floating on the ignition circuit, or by other types of chargers.

Heating Boiler

The exhaust heat economizers installed on main engine exhausts cannot be relied upon to furnish all heat requirements of the main building since an engine or two may not be operating when maximum heat is needed. Furthermore, it is impractical to distribute heat from these economizers to other plant buildings. It is necessary to install a small heating boiler in the auxiliary building to supplement the heat economizers in the main building and to furnish all heat requirements of other structures.

Machine Shop

It is unnecessary to equip each main-line station with complete shop equipment. Usually most machine work can be done by shops in nearby towns. On a long transmission system, however, it is advisable to equip one or two stations with a fair assortment of tools consisting of a large lathe, small lathe, metallizing equipment, shaper, large drill, small drill, large and small grinders, power saw and portable cylinder boring machine. All such machine tools are placed in the auxiliary building with the exception of the portable boring machine which is moved from station to station as needed, and usually set up in the main building where cylinders can be rebored on the operating floor.

Water-Treating Equipment

Proper water treatment is a vital necessity and this equipment should be installed in the auxiliary building. Much has been learned during the past few years about water treatment and there is a present trend toward combination lime-sodium zeolite treating plants and away from the customary single-treatment installations so often selected in the past. This subject deserves every consideration, in that a correct solution will minimize the most troublesome and expensive item in the plant operator's book.

Elevated Water-Supply Tank

This tank should be of sufficient

capacity to operate the plant equipment for at least ½ hour and preferably for 1 hour in the event of generator or other temporary trouble with auxiliary equipment. It should be connected so as to float on the cold-water discharge line to the engine jackets and immediately supply an uninterrupted flow thereto in the event of pump stoppage. Usually the top of the elevated tank shell should be about 50 ft. above the main engine room floor. Standpipes are good substitute for the conventional elevated tank, some of which have been recently installed and are in successful operation.

Water Cooling-Gas Cooling

Combination cooling of jacket water and compressed gas by means of atmospheric cooling towers is the most prevalent arrangement in station design. The forced-draft cooling tower, however, is gaining in popularity and should be given equal consideration when planning cooling facilities. Comparison of initial investment, space requirements, operating and maintenance costs should be investigated. In both types of towers the tubular gas coolers are installed near the bottoms of the structures to allow for maximum cooling of jacket water before being reused for gas cooling. After passing the gas coolers, the water is collected in the cooling-tower basin from which it is recycled through the engine jackets and to other plant equipment. Some tempering or regulation of jacket-water inlet temperature can be accomplished by bypassing part of the warm water pumped over the cooling tower directly into the cooling tower basin. Atmospheric cooling towers should include winter distribution systems, if installed where cold winters are experienced, in order to prevent icing up and possible collapse of the towers due to ice load.

Algae Control

Algae growth in cooling towers should be prevented or controlled. This is generally done by means of periodical chlorine injections into the cooling-water supply, or through the use of other effective chemicals.

Domestic Water Supply

Freshly treated well water is usually stored in an elevated water tank in the cottage area for domestic purposes. An underground automatic pressure system may be preferred and is an entirely satisfactory arrangement. In any case, frequent pollution checks should be made on the domestic water supply to protect the health of users and if positive indications are present, suitable dosages of chlorine compounds should be employed to neutralize the condition.

Water Wells

A station must have an ample supply of good water and in most cases this is obtained from deep wells. It is advisable to develop wells in sufficient number to enable 5 per cent of the quantity of water normally circulated over the cooling tower to be pumped from the wells to satisfy all station requirements, and to have one additional well in reserve. This quantity of water should take care of all makeup requirements, domestic, irrigating and other incidental uses.

The electric-motor-driven deep-well turbine is well suited for compressor-station service. When wells are situated any considerable distance from the plant it is advisable to install remote controls for operation of the wells from the station.

High-Pressure Gas Piping

The high-pressure gas suction and discharge piping in the station, and especially in the manifold area, should preferably be installed aboveground where it is readily inspected, and can be maintained in first class condition. The practice of placing such piping below the ground is hazardous, unless it is periodically uncovered for inspection and reconditioning.

Likewise it is recommended that all small air lines and electric conduits in the plant area be installed overhead if a suitable arrangement can be worked out. Although this may detract some from plant appearance it will result in lowered maintenance expense and fewer service interruptions.

Station Side Gates

Station suction and discharge valves at connections with the main line should be of the lubricated-plug type to allow for quick closing in the event of trouble at the plant. In case of a line break or fire it is of paramount importance to close these valves in minimum time. Remote controlled, piston-operated plug valves are coming into use for those locations. Main-line pressure is used for their operation and one or more control points may be installed at safe distances from the plant buildings or danger areas.

Gas Cleaners

It is necessary, for protection of the compressors, to install gas cleaners in the suction line for removal of all foreign material. Dirt, pipe scale and liquids are present in any pipe-line system and their elimination at each station will prevent expensive maintenance to and improve performance of the equipment.

Plant Buildings

Plant buildings should be of steel-frame construction. Recommended for closure material are brick curtain walls below window sash, with remaining siding and roofing of corrugated transite. Although the initial cost of such buildings is high, this is offset by low maintenance, fine appearance, the suppression of noise and other advantages. Wood or other inflammable materials should be excluded from the buildings.

Employes' Cottages

Comfortable, modern dwellings should be provided for employes who are to be housed at the station. It should be possible for these employes to enjoy all the conveniences found in homes in an average community. Garage space, garden plot, recreational facilities for children and adults, all should be provided if possible. Remotely situated stations, where most employes may be housed on the site, should also be provided with a community hall. In this building may be a large assembly room in which employes' meetings can be held and which could be used for dances or parties, also a small kitchen, a room for pool table and card tables, and a small library room.

Compressor Station of the Future

The horizontal gas engine for main-line gas-transmission service has had a long and satisfactory record of performance. The vertical engine is also enjoying its share of popularity in this field. In the station of the future, however, we may see a new form of compressor unit taking the place of the old standbys of today. Important developments have been made within the past few years in combustion gas turbines and centrifugal compressors, and in the postwar period these newcomers will command attention and will deserve serious consideration.

Tom Matson, who was geologist for Kingwood Oil Co. in Illinois, has entered war service and is undergoing air training at Amarillo, Tex.

R. M. Wilson, geologist for Ohio Oil Co. in Shreveport, was chosen president of Shreveport Geological Society at the annual meeting. **E. P. Ogler,** of W. C. Spooner's staff, was elected vice president; **L. H. Meltzer,** Union Producing Co., secretary-treasurer.

Charles Manlove has been appointed division geologist for Union Oil Co. of California in the Santa Maria district, and **Aden Hughes** has been appointed division paleontologist for the same district, with offices at Orcutt.

Robert B. Campbell, consulting geologist at Gulf Hammock, Fla., has been elected vice president of the recently organized Southeastern Geological Society. As president of Peninsular Oil & Refining Co. Campbell supervised drilling of the 1 Cory, in Florida, to total depth of 10,000 ft., which demonstrated the presence of Comanchean rocks in that region and was a prologue to Humble Oil & Refining Co.'s discovery at Sunniland.

A.G.A. ABSTRACTS

Long-Distance Transmission

Interior Cleaning of Natural Gas Pipe Lines

D. K. STEPHENS, superintendent, transmission pipe lines, Panhandle Eastern Pipe Line Co.

A LOW over-all efficiency in a pipe line does not necessarily indicate that the entire line is bad. For instance, if the pressure drop for a certain rate of flow over a given distance, say the distance between two compressor stations, is greater than the theoretical curve expectancy, the trouble may be found to exist for a few miles only, resulting from a concentrated bottleneck.

A total of 346 miles was run by a gas pressure go-devil in cleaning 260 miles of 24-in. line, inside walls of which were thinly coated with foreign matter. Total cost of the cleaning operation was $69 per mile, not including value of gas used. The efficiency of individual sections of line was increased 11 per cent to 27 per cent, and the over-all efficiency was increased from 74.7 per cent to 93 per cent.

This method of cleaning is extremely satisfactory in instances when the pipe line is dry and the film of foreign matter has hardended into a crust on the walls of the pipe. Brushes or scrappers will break the incrustation, and most of it can be removed by blowing. However, it is another story when the substance is oily or gummy, or when the pipe line is wet.

Last year, we were confronted with the cleaning of approximately 85 miles of 24-in. main lines, and the same amount of 24-in. and 26-in. loop line which was in this condition. A trial run with the go-devil through one of the worst 8-mile sections of line proved that some other method of cleaning would have to be devised. The laboratory recommended the use of Aerosol OT 100 per cent, proportioned, 50 gal. of saturated solution of Aerosol to 1,000 gal. of water.

This method of cleaning increased the over-all efficiency of this portion of our line from 74.7 per cent to 92.5 per cent.

Gas Dehydration

E. G. HAMMERSCHMIDT, Texoma Natural Gas Co.

TEXOMA NATURAL GAS CO. erected a plant at Fritch, Tex., designed for drying 80,000,000 cu. ft. of gas per day at operating pressure of 740 p.s.i. The granular desiccant fills the towers to a depth of 18.5 ft. Moist gas enters the top of the tower, and dehydrated gas leaves the bottom 13 seconds later. The adsorbent is reactivated by passing hot gas through the bed in reverse flow to the drying cycle.

Greater pressure losses occurred across the adsorbent bed than had been anticipated. In general, it was found pressure losses vary directly with the density of the gas, the velocity of the gas remaining constant. Pressure losses can be reduced by using a larger mesh desiccant only at the expense of reducing the moisture capacity of the desiccant.

A small pilot plant was erected for studying the rate of decline of commercial adsorbents. Included, were alumina such as originally charged to the commercial unit; Florite, silica gel, and solid calcium chloride. In addition to the pilot-plant tests, small samples of various desiccants were placed in the top of a commercial unit for observation.

At the end of 2.9 years (150 weeks) the original charge of 20,000 lb. alumina dehydrated a total of 6.6 billion cu. ft. of natural gas. The same amount of Florite dehydrated 35.5 billion cu. ft.

These abstracts summarize several papers delivered at the Natural Gas Spring Conference at French Lick, Ind., May 11-13. General papers appeared in the May 11 Journal and the News Section of this issue contains a summary story on the meeting.

Some Maintenance Features Of a 22-In. Transmission Line

W. K. BORLAND, in collaboration with A. W. SOMERVILLE and D. H. GRAHAM, Mississippi River Fuel Corp., St. Louis.

THE author discusses the operation and maintenance of the company's transmission lines, with emphasis on problems of maintenance on the line, extending 431 miles from Perryville, La., to St. Louis. In order to supply additional strength to the line at 14 river crossings welding sleeves have been placed over the Dresser couplings. The maintenance crew spends considerable time in keeping the channels of the small streams open and unobstructed above and below the pipe-line crossings.

The paper discusses the measures used to cope with flood conditions, particularly of the Arkansas River. Protection of the line from corrosion is discussed. The most satisfactory method for applying protection was found to be a system using carbon anodes for the ground bed. Anodes are installed vertically in the ground 10 ft. from the pipe line, and are connected to a rubber-covered wire buried parallel to the pipe line. The line is connected at 175-ft. intervals to a d.c. feeder carried on the telephone-line poles. The feeder receives its current from rectifiers installed at ½-mile intervals.

Dehydration of High-Pressure Gas

W. F. FULTON, United Gas Pipe Line Co., Shreveport.

A MODERN diethylene glycol plant consists of contactors constructed of heavy plate to stand pressure up to 2,000 lb. and range in diameter from 36 to 60 in. with four bubble trays for contacting the gas and glycol. They have a scrubber section in the base to remove entrained liquids.

Gas enters the scrubber section, passes through the bubble plate counterflow to the glycol which enters at the top. The gas passes from the top of the contactor and goes to the metering station on the main line through a back-pressure regulator which holds a constant pressure on the contactor. The glycol level in the contactor is held constant by a high-pressure level control.

The saturated or rich glycol leaving the contactor goes to the heat exchangers, where it is heated by the hot lean glycol coming from the still. The lean glycol is cooled and goes to the surge or storage tank to be returned to the contactors by gas engine or motor-driven triplex pumps.

The glycol entering the still is further heated by the reboiler, and the water is fractionated from the glycol which then passes through a level-control valve to the exchangers where it is cooled, and then into the storage tank for returning to the contactor.

The average loss of glycol per million cubic feet is 0.4 of a pound, or approximately 0.03 of a gallon. The cost of dehydration per million cubic feet is 2 to 6 mills.

Maintaining South Louisiana Gas Lines

E. R. CUNNINGHAM, general superintendent of main pipe lines, United Gas Pipe Line Co., Shreveport.

DEVELOPMENT of a so-called bath tub which is assembled on pipe lines in marshy land or submerged under water for facilitating repair operations is described. The bath tub seals out water or mud from a segment of the line, enabling crews to make repairs on band clamps, split sleeves and welds.

Cost of first internal cleaning of main transmission lines is reported in the paper to be approximately 0.15 cent per foot per inch of diameter. Cost decreases to 0.1 cent per foot per inch of diameter when cleaners have been previously run. Cleaning of 647 miles of line raised the efficiencies an average of 11.5 per cent. To attain the same increase by construction of loops would have required approximately 168 miles of line. The cleaning program is being correlated with the regular summer maintenance work.

Underground Storage

Natural Gas Underground Storage Northern Pennsylvania

J. H. ISHERWOOD.

STORAGE was commenced February 1940 and injection and extraction was continued until March 25, 1943, at which time the North Penn Gas Co.'s storage was completely withdrawn in the Palmer area, Tioga County, Pennsylvania. The total cumulative amount placed in storage to March 25, 1943, was 2,318,129,000 cu. ft. Cumulative withdrawals were 2,318,129,000 cu. ft.

Additions to storage were resumed in February 1940 and net gas in storage increased to a maximum of 1,410,000,000 cu. ft. in October 1941, with reservoir pressure of 225 lb. Withdrawals were begun in November 1941 and continued through April 1942, when remaining net gas in storage was 371,900,000 cu. ft. and reservoir pressure of 94 lb. A yield per pound drop check for this takeout cycle shows 1,038,100,000 cu. ft. withdrawn with resulting reduction of reservoir pressure of 131 lb. or a yield of 7,900,000 cu. ft. per pound drop in pressure.

Additions to storage were begun again in May 1942 and net gas in storage reached a maximum of 903,000,000 cu. ft. in October 1942, and reservoir pressure of 193 lb. Withdrawals began in October 1942 and were continued to complete exhaustion in late 1943, with remaining reservoir pressure at this time of approximately 53 lb.

In addition to the larger storage area, referred to as the Palmer area, we completed a smaller area in the same Farmington field as a storage area. This area, referred to as the Meeker area, is of smaller extent, and entirely separated from the main area by faulting and salt water enclosure.

Net gas in storage reached a maximum of 428,300,000 cu. ft. in September 1943, with reservoir pressure of 210 lb. Withdrawals from storage began in October 1943, and have continued almost to complete exhaustion as of April 1944. Indications are that

(Continued on page 119)

A.I.M.E. ABSTRACTS

Accompanying abstracts are of papers presented at the annual spring meeting of the Petroleum Division of the Institute of Mining and Metallurgical Engineers, at Houston, May 8-10. The meeting was held in conjunction with a regional meeting of the A.I.M.E., as a joint session.

Color Tests in Core Analysis

E. R. PHILIPP, The Atlantic Refining Co.

THIS paper presents a method of detecting oil saturation in cores provided the oil carries a coloring agent. The method is helpful in determining the interval in a well from which it may be possible to obtain production. Carbon tetrachloride has been found to be the most efficient solvent in extracting the oil color and has several advantages over other solvents. Color testing is done on the residual-oil content of the cores. The percentage of residual fluids remaining in the cores is dependent upon the characteristics of the sand or lime itself and other outside influences. The color indicates the relative amount of oil, if any, remaining in the core. The greatest concentration will be in all likelihood the point of deepest color.

While color testing data must be used with discretion, if the person making the tests has good knowledge and experience, the prediction of the type of production may be made quite satisfactorily. An important advantage of color testing is that any unnecessary core analysis can be eliminated. Correlation of color tests with other pertinent data is often useful in determining the gas-oil and oil-water contacts in reservoirs. It is also useful in determining, within limits, whether or not a formation contains gas, oil or water, or a combination of the three.

The Equilibrium Water Vapor Content of a Natural Gas

GEORGE F. RUSSELL, ROBERT THOMPSON, FRANK P. VANCE and R. L. HUNTINGTON, School of Engineering, Oklahoma University.

THE removal of water vapor from natural gas is an important operation in connection with the production and long-distance transportation of the commodity because: (1) Liquid water accelerates internal corrosion of a pipe line; (2) accumulation of water at low points in a pipe line reduces markedly its capacity; (3) gas hydrates, icy snow-like growths, form readily under high pressure in the presence of the lower hydrocarbons and water, often plugging up the pipe line.

The importance of the experimental data necessary in designing dehydration plants for stripping the gas of its water content prompted experimental work along this line by the authors. The paper deals with the experimental apparatus and details of the tests performed.

Decline Curve Analysis

J. J. ARPS, British-American Oil Producing Co.

THE author presents a brief review of the development of decline curve analysis during the past 3 or 4 decades.

The two main types of decline curves, exponential and hyperbolic, are discussed in detail and the mathematical relationship between production rate, time, cumulative production and decline percentage for each case studied. The well-known loss-ratio method was found to be an extremely valuable tool for statistical analysis and extrapolation of various types of curves. Some new graphical methods are introduced to facilitate estimating the future life and the future production of producing properties, with curves plotted on semi-logarithmic paper.

To facilitate graphical extrapolation of hyperbolic type decline curves, a series of decline charts, are proposed which will make straight-line extrapolation of both rate-time and rate-cumulative curves possible.

An Introductory Discussion of The Reservoir Performance of Limestone Formations

A. C. BULNES and R. V. FITTING, JR., Shell Oil Co., Inc.

FIELD experience with limestone and sandstone production indicates the existence of wide differences between the reservoir behavior of these two types of formations. Differences in reservoir performance are to be expected in view of the differences in composition and evolution of limestone and sandstone. Two kinds of porous media are recognized, namely, intergranular and heterogeneous.

The partial relationship between porosity and permeability of any class of porous media is represented by an area of finite extent and definite shape on the permeability-porosity plane. It is attempted to delineate the area correspondingly to the class of intergranular porous media by plotting the porosity and permeability of several thousand samples of sands and sandstones. The region outside this area corresponds to heterogeneous media.

This paper also discusses the horizontal and vertical variations of porosity and of permeability in limestones and sandstones. In addition to this, comparisons are made of connate water content, the relative permeability saturation relationship and capillary phenomena in the two kinds of rocks, are discussed.

Well Cementing

RAY S. KARL, Baker Oil Tools, Inc., and B. C. CRAFT, Louisiana State University.

THE paper sets forth methods whereby the entire annulus may be filled with cement, by replacing the mud rather than inserting small bridges or dams by squeeze cementing. During both primary and secondary cementing jobs some of the most important properties of cement are so commonly overlooked that full advantage is seldom obtained from it. Coning rarely occurs, unless a zone is produced or dissipated. It occurs particularly when a zone is not adequately protected and generally applies to gas as well as water associated with oil production.

The paper deals with the characteristics of cement, primary casing cement jobs, squeeze cementing and plugging back. From the study made by the authors, several important conclusions were drawn:

1. Squeeze cementing has demonstrated that better cementing of casing would benefit production, including reserves, and better primary jobs are now possible.
2. Displacing mud with cement effectively replaces a fluid with a solid and is considered superior to squeezing against a colloidal fluid because it covers a much longer section of the well annulus.
3. Heavy cement slurries displace mud better and are less likely to be lost in formation and provide a more permanent impermeable bridge with minimum porosity.
4. Adequate mass area with the centering of casing for uniform cement placement provides maximum strength, minimum channeling.
5. The maximum amount of production is recoverable from a reservoir when the primary cementing of casing is perfect.

The Use of Modified Starch in Gulf Coast Drilling Muds

G. R. GRAY, Baroid Sales Division, National Lead Co.

THIS paper presents a number of examples where modified starch has been used in drilling muds in the Gulf Coast area. Its use has afforded a means of overcoming or avoiding a number of troublesome conditions which frequently arise during the drilling operations in that area, such as sloughing shales, poor hole condition after salt-water flow, or having to set casing to continue drilling through salt beds.

In discussing general procedure for field operation, it is obvious that a commercial starch product which can be added directly to the drilling mud without preliminary treatment has time-saving advantages. Starch can be added to the mud through the conventional hopper in the same relatively simple manner as clay. In the field, first consideration should be given to the means of preventing fermentation. The addition of creosote, sodium, pentachlorphenate, or phenol will reduce possibility of fermentation. It can be prevented by maintaining a high concentration of salt or alkali, or high mud temperatures.

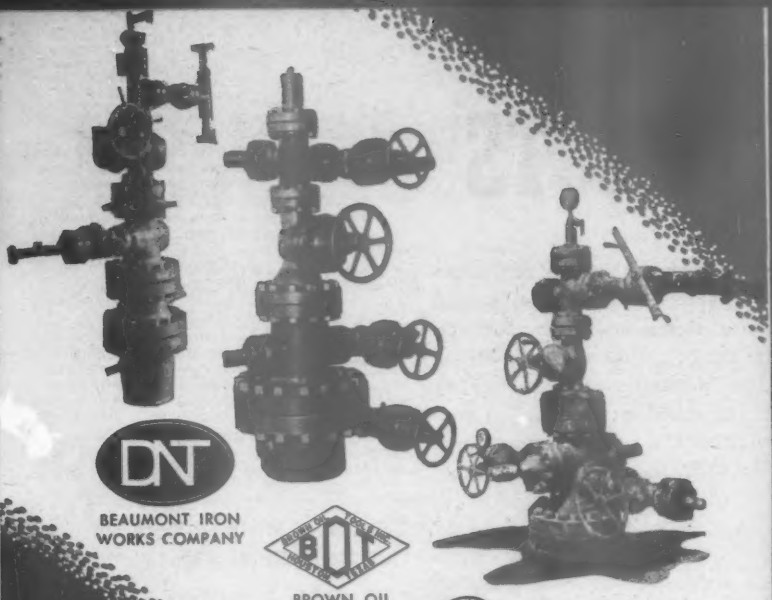
Characteristic instances of the use of modified starch in Gulf Coast drilling muds have been presented which demonstrate that neither the preparation nor the maintenance of such low water-loss muds is especially difficult or expensive.

Examples are shown in the paper as to how trouble from caving shales was avoided and a comprehensive coring and testing program was carried to a successful conclusion; how a long string of casing was set at the desired depth after a salt-water flow; how a mud of good wall-building qualities was made from brackish water, and how at least one string of casing was saved after a well penetrated rock salt.

Application of the Electric Pilot To Well Completions, Acidizing And Production Problems in The Permian Basin

P. S. LEHNHARD and C. J. CECIL, Dowell, Inc.

THIS paper describes the use of the electric pilot in the Permian basin for making permeability surveys of wells and for the selective acidization of wells. A general survey of the information obtained from the many permeability surveys run in this area is given, and the possible application of this information to reservoir control problems is discussed. The application of the electric pilot on specific wells, involving well completion, acidizing, and workover operations is also included.



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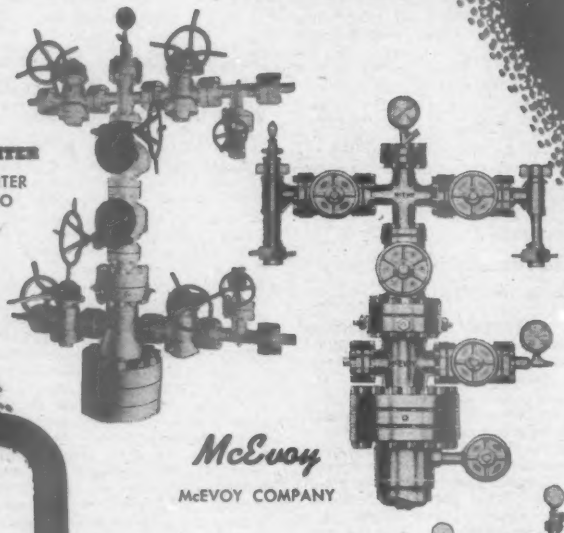

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Greater Depths and Hard Formations Increase Ordovician Drilling Costs

by Joseph C. Gordon

Development of Ordovician production in fields of the Permian Basin of West Texas is being extended and accelerated. To date, the Ordovician has proved productive in 12 fields of the area. Four of these, all opened since 1943, are in northern Ward and Winkler counties, where the producing section is found at greater depths than in most of the previous fields, and where a greater amount of chert must be penetrated. This has made completion costs in these two counties exceptionally high.

THE greater depths which must be drilled and thick chert beds that must be negotiated in development of Ellenburger (Ordovician) production in northern Ward and Winkler counties, West Texas Permian basin, are adding appreciably to the drilling difficulties and completion costs in the development in this area.

Ordovician production has been discovered in four fields in northern Ward and Winkler counties since 1943. These fields (see accompanying tabulation) are Monahans, Keystone, Kermit and Wheeler. In these fields top of the Ellenburger has been encountered between 9,525 and 10,690 ft. The section is predominantly lime and the Devonian section is present in the area with broken chert encountered in that section and also to some extent in the Simpson and Ellenburger formations of the Ordovician. The chert section of 250 to 700 ft. has an actual footage of solid chert of from 100 to 150 ft. Slow progress is made in drilling solid chert, rates being retarded in some cases to 24 hours per foot with a service of only 6 in. per bit. Loss of water from drilling mud in the fractured and porous formations penetrated is high and the cost of mud and mud-conditioning chemicals is great, being between $1.50 and $2.50 per foot of hole.

Two Completions in Monahans

Two wells have been completed in the Monahans field. The first well was completed at a total depth of 10,090 ft. Casing was set as follows: 16-in. at 90 ft.; 10¾-in. at 3,308 ft., and 7⅝-in. at 10,062 ft. The second well was drilled to 10,496 ft. and plugged back to 10,423 ft. Casing was set as follows: 16-in. at 50 ft.; 10¾-in. at 724 ft.; 7⅝-in. at 3,481 ft., and 5-in. at 10,478 ft.

Casing was perforated with 211 ⅝-in. shots between 10,350 and 10,420 ft. Due to slow progress in drilling the lime and chert, some trials were made with large diamond-core bits. Heavy gas-engine-powered and steam rigs are now being used in the Keystone field. Usually one 18-in.-stroke mud pump is used with a smaller mud-mixing pump for a standby. The broken chert section is about 600 ft. thick and contains as much as 120 ft. total chert. One well, now being completed, drilled the 600-ft. broken chert section with 60 bits. Drilling in solid chert may require 10 to 12 hours per foot with a footage as low as 12 in. per bit. A well now being completed at a total depth of 9,835 ft. used 170 bits and required 207 days for completion. Various casing programs have been used. One well was completed with 7-in. casing at 9,551 ft., which is below the gas-oil contact. One well was completed with 5½-in. oil string set through the formation, with 13⅜-in. 48-lb. H-40 at 350 ft.; 9⅝-in. 40-lb. J-55 at 4,900 ft., and 5½-in. 17-lb. J-55 and N-80 at 9,678 ft. (bottom).

One well which was drilled to granite at 9,858 ft. set 7-in. casing at 9,675 ft., and is producing from open section below casing as well as from perforations in casing below the gas-oil contact. Two wells have been completed using the following casing program: 13⅜-in. 48-lb. at 350 ft.; 9⅝-in. 40-lb. at 4,900 ft., and 5½-in. 17-lb. at 9,635 ft.

In these two wells the hole was reduced at casing seat and ratholed 4¾-in. to completion depth.

In a well nearing completion the operator has set surface and intermediate strings and plans to set 7-in. 23-lb., 26-lb. and 29-lb. pipe to approximately 9,650 ft., which is below the gas-oil contact. The well has 13⅜-in. casing at 2,248 ft. and 9⅝-in. casing at 4,968 ft. After casing has been set, it will be perforated opposite center of the gas cap and the well produced from this section until adequate samples of the gas and fluid are obtained for a thorough laboratory study. These perforations then will be squeezed off and the well completed to produce from below the gas-oil contact.

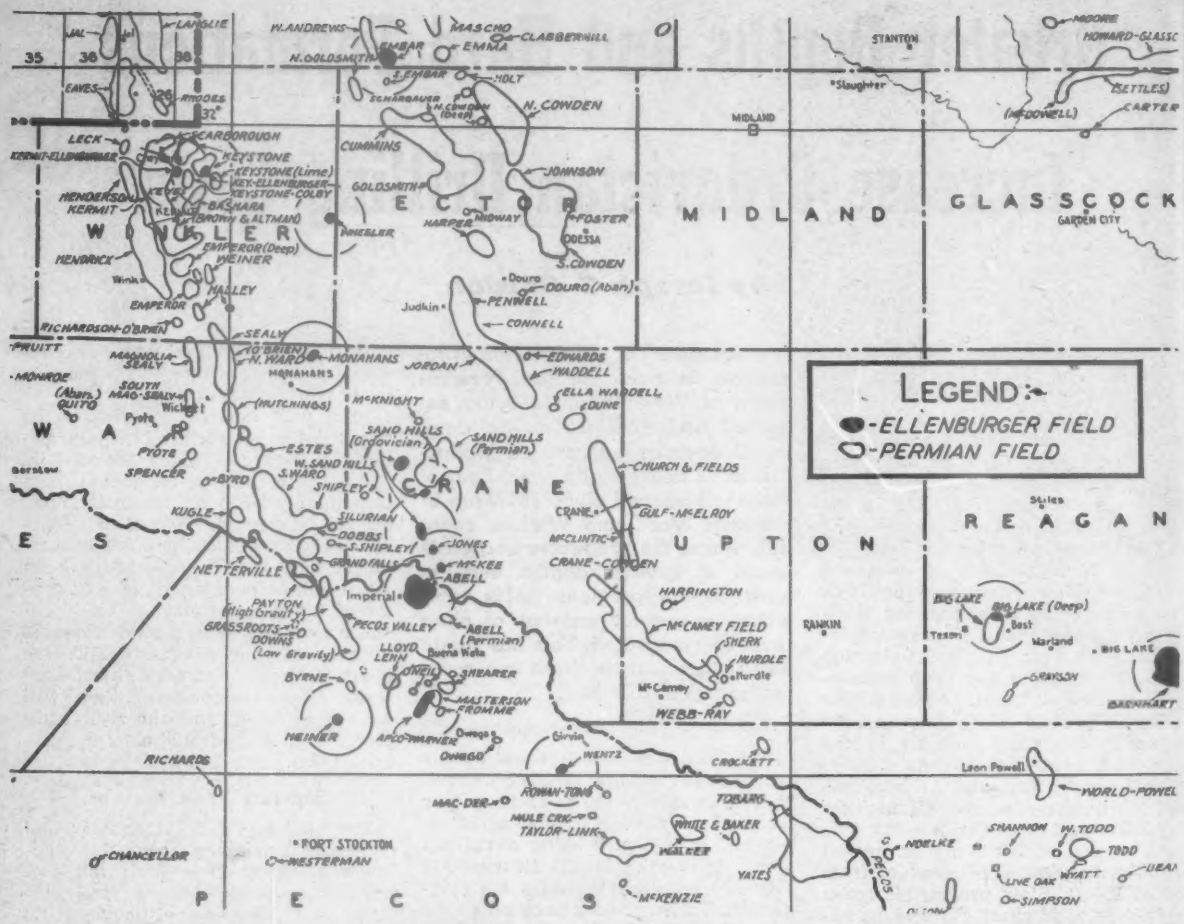
Separate Tank Bottoms

The oil has 43° A.P.I. gravity and on leases producing from the shallower Keystone lime and Holt formations requires separate tank batteries for handling although it is batched through pipe lines of the purchasers.

Bottom-hole temperatures of 150° F. have been recorded in this field. The Kermit field has three wells completed to depths between 10,680 and 10,896 ft. Heavy steam rigs powered by 14-in. steam engines and having 18-in. mud pumps are used. Wells have encountered between 130 and 150 ft. of chert. Drilling this chert in some cases has retarded drilling to 24 hours per foot and a footage of 6 in. per bit. Between 257 and 311 bits per well are used. Completion time for second and third wells was 215 and 197 days. The Woodford shale is reported to have given some trouble,

ORDOVICIAN FIELDS OF PERMIAN BASIN, WEST TEXAS

Field and county:	Discovery year	Depth, top of pay (ft.)	No. wells with casing point: Top of oil pay	Below gas-oil contact	Set through and perf.	Total wells
Abel, Pecos	1941	5,830				9
Apco-Warner, Pecos	1939	4,500	12	0	26	38
Barnhart, Reagan	1941	9,100	9	2	17	28
Big Lake, Reagan	1928	8,200	26	0	0	26
Embar, Andrews	1942	7,700	3	1	16	20
Heiner, Pecos	1941	5,382	2	0	0	2
Kermit, Winkler	1943	10,500	0	0	3	3
Keystone, Winkler	1943	9,525	0	4	1	5
Monahans, Ward	1943	10,080	1	0	1	2
Sand Hills, Crane	1936	5,800	30	0	2	32
Wentz, Pecos	1941	4,300	2	0	0	2
Wheeler, Winkler	1943	10,490	0	0	3	3



Portion of Permian Basin area of West Texas showing fields in which Ellenburger (Ordovician) production has been found

showing a tendency to slough into the hole. Casing has been set through the pay formation in all wells.

The second completion used the following casing program: 13⅜-in. at 2,308 ft.; 9⅝-in. at 8,273 ft., and 5½-in. J-55 and N-80, set through producing section.

The third completion set the following casing: 20-in. at 179 ft.; 13⅜-in. at 2,370 ft.; 9⅝-in. at 6,429 ft., and 5½-in. J-55 and N-80 set through producing section. Bottom-hole temperatures average 150° F.

The oil is of 43° A.P.I. gravity and is handled in individual tank batteries to segregate it from the oil from the shallower Permian zone.

Steam rigs have not been used in the Wheeler field, Winkler County, because water is scarce. The heavy rigs used are equipped with a 15 or 18-in.-stroke mud pump and a smaller mud-mixing pump for a standby. A chert section of about 600 ft. is encountered containing a total of about 120 ft. of chert. Drilling the solid chert frequently requires 5 hours or more per foot and service of 1 to 3 ft. per bit is obtained. One well completed in 230 days used a total of 220 bits and another well completed in 206 days required 215 bits. Maximum depth penetrated in the field is 10,725 ft.

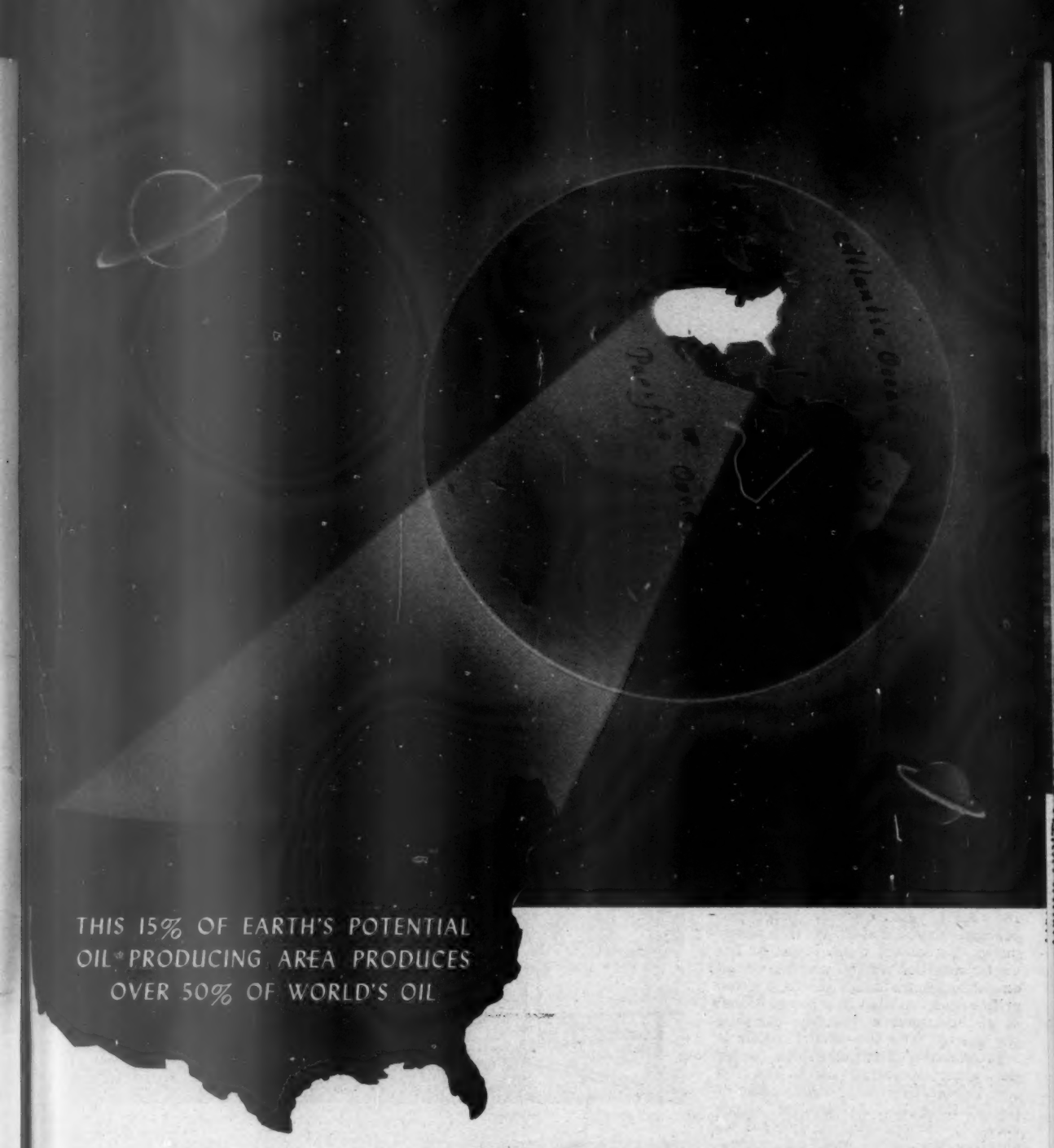
Casing Practice

Practice in this field has been to set casing through the producing formation and gun perforate the section to be produced. The present casing program in the field is 13⅜-in. at 200 ft.; 9⅝-in. at 3,500-3,800 ft., and 5½-in. 17 and 20-lb. J-55 set through the producing formation. Oil produced is of 43° A.P.I. gravity.

Prior to 1943, Ordovician production had been found in eight other fields in the Permian basin. These fields are listed in the accompanying tabulation. The Devonian section was missing in all these fields and very little chert was present. In none of them was any great difficulty experienced in drilling, beyond slow progress through lime sections penetrated, and mud problems in the porous and water-bearing zones encountered.

Recent personnel changes announced include **W. H. Linton,** manager, Sun Oil Co., Marcus Hook to Philadelphia; **D. H. Handley,** engineer, Magnolia Pipe Line Co., Brownsboro to Teague, Tex.; **R. C. Kendall,** geologist, Shell Oil Co., Inc., Graham to Gainesville, Tex.; **W. D. McIntyre,** superintendent, Danciger Oil & Refining Co., Houston to Danciger, Tex.; **Fred H. Wilcox,** geologist, Magnolia Petroleum Co., Midland to Dallas; **F. L. Lively,** superintendent, Humble Oil & Refining Co., Morgan City to Bell City, Tex.; **William W. Hearn,** superintendent, War Emergency Pipe Lines, Plainfield, N. J., to Houston; **H. R. Shannon,** superintendent, Carter Oil Co., Billings, Mont., to Powell, Wyo.; **Alexander W. McCoy, III,** geologist, Carter Oil Co., Billings, Mont., to Fort Morgan, Colo.; **William F. Davis,** engineer, Oklahoma Pipe Line Co., St. Elmo, Ill., to Tulsa; **N. F. Jones,** superintendent, Oklahoma Pipe Line Co., Tulsa to Seminole, Okla.; **R. E. Baker,** engineer, Shell Oil Co., Inc., Tulsa to Houston; **D. T. Luttes,** engineer, Oklahoma Pipe Line Co., Wewoka, Okla., to Jackson, Miss.

G. Dewey Goodman, field production superintendent in the Shreveport, La., district for Union Producing Co., has been transferred to the Monroe district as field drilling and production superintendent.



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PLANT PRACTICES

Pistons Without Rings

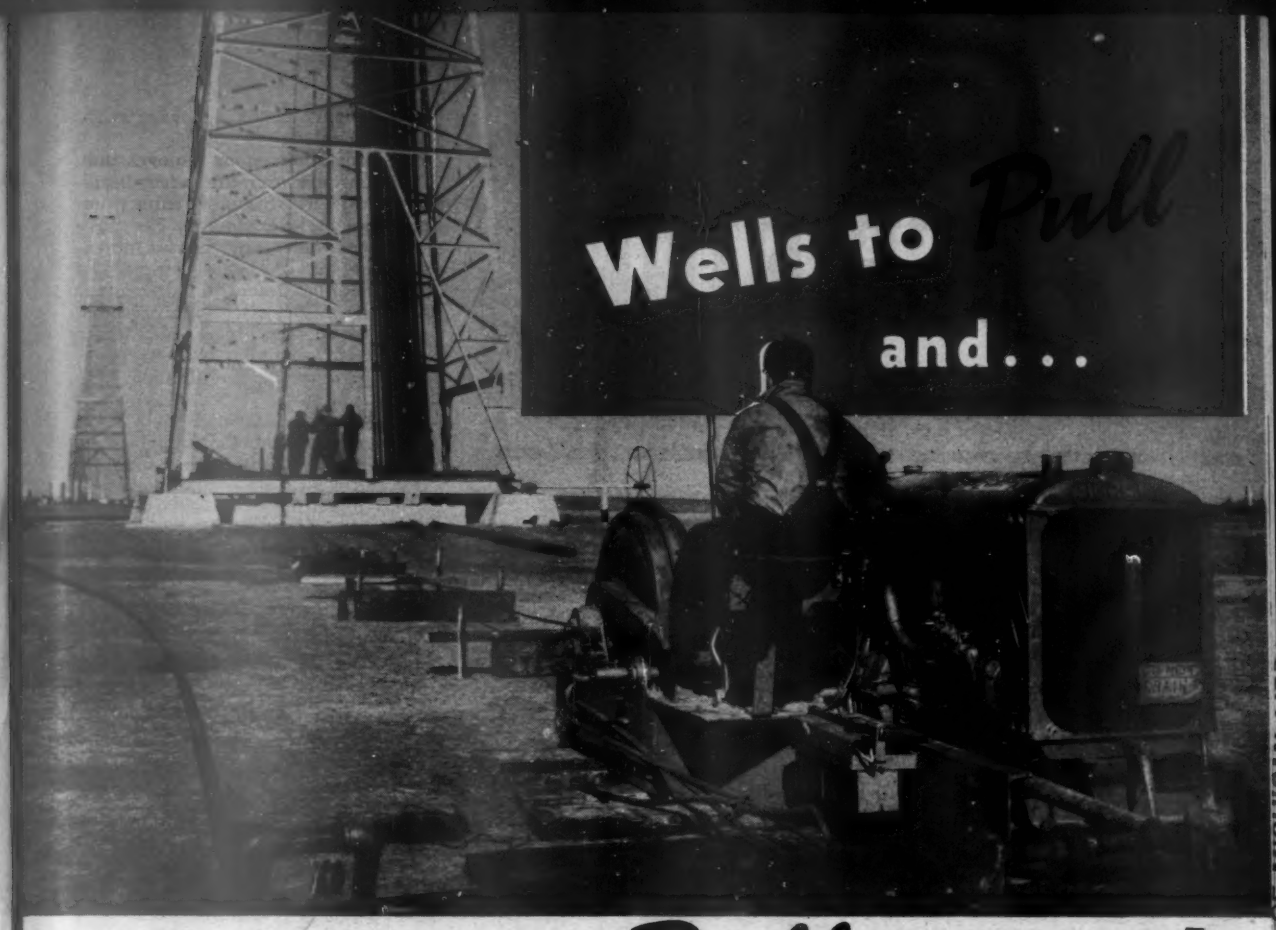
EXPERIMENTING with pistons for a 14-in. by 6-in. by 10-in. duplex steam pump used to handle 21° gravity topped crude at a discharge pressure of 400 lb., under an average temperature of 565° F., revealed interesting results. The pump was originally equipped with conventional fluid pistons, but after a term of operating, required replacements. The experiment was conducted with solid pistons, having a ring groove, ¼ in. wide and ¼ in. deep turned in the longitudinal center. The clearance at first was set at 0.010 in., fitting into the liners with this tolerance. At first try, the pump performed with excellent deliveries but soon showed a reduction in efficiency, and a second set of pistons was made. A local foundry cast these pistons—which are 6 in. long and 6 in. in diameter—by pouring into the forms a melt of close-grained gray cast iron. The pistons were finished on a lathe, using the same type of groove in the center as the first pistons, but grinding the size for a slip fit into the liners dry.

Slurry Agitator Lubricated

SLURRY creep from the mixing and agitation vessel into the packing gland of the mixing unit caused scoring of the shaft. A sleeve connected to the inside of the stuffing box, between the packing and the impeller, with sufficient clearance to prevent riding the shaft at any time, reduced the slurry contact area. A line from the main column of the plant where 18° A.P.I. gas oil was produced brought this material to the slurry pump. To control the amount of gas oil flowing behind the packing gland and through the small sleeve, a fixed orifice was installed in a conventional ¼-in. lip union in the line carrying the gas oil. The size of the orifice is approximately 1/16 in., which, under the plant operating conditions fed just enough lubricant to the inside of the stuffing box to prevent slurry creep to the packing. As the gas oil entering the sleeve for shaft protection is the same kind of stock as the slurry vehicle, no difficulty is encountered because of the shaft wash.

Gang Lubricator

SETTING a six-pump lubricator on a bracket between two steam pumps, one of which is operated constantly, furnishes adequate cylinder oil for several units. The advantage of this method is reflected in the maintenance of lubrication. The operator needs to fill only one reservoir, and the amount of oil to the individual pump is governed by the length of the pump stroke on the lubricator. The cost of installation is reduced, and maintenance is necessary on only one instrument.



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The Model E has a maximum line pull of 58,970 ft. lbs. Available in single or double drum type. Eight line speeds on the winch drum to 1,074' p.m. at 1,200 engine r.p.m. Engine develops a torque of 400 ft. lbs. Fuel: Butane, natural gas, gasoline, or distillate.

Allis-Chalmers equipment has been called upon to maintain a large percent of the "wells on pump" in this country. Their manufacture for the oil industry has never ceased—and now they are being delivered in increasing numbers.

Every unit that has been produced during the past twenty-five years has had the same excellent engineering and painstaking care in manufacturing — practices that are now enabling producers to maintain their wells under adverse conditions, as A-C Units do extra duty.

Front Lines in

REFINING

by Arch L. Foster

Electronics Is Science, Not Magic

IT appears that much of the present day design and development work in the electronics field (military needs aside)," said Dr. J. D. Ryder of Iowa State College recently, "is being done by the sales manager and the advertising man — the engineers are too busy with other things." With this blast the good doctor, rightfully we believe, impaled irresponsible imaginations on the halberd of fact. We say "irresponsible imaginations," meaning those which use some isolated facts or supposed facts as the totally insufficient ground and basis for far-fetched daydreams of what is to come postwar. The responsible type of imagination is working in numerous shops and plants now, to make some of those dreams into realities, and these dreamers cannot be encouraged too much.

Electronics is defined as that field of devices which operate because of the passage of electrons through a gas or through a vacuum. This definition distinguishes between what might be termed "electrics" or ordinary power electricity, and electronics. Electricity is that phenomenon wherein a stream of electrons passes through solid or liquid conduits or conductors. Electronics is typified by the operation of neon lights, radio tubes, X-rays tubes, fluorescent lights and similar equipment. Obviously these items include a large proportion of the present-day electrical field.

Since electronic devices, for example control systems, have been introduced to carry out jobs already being handled by other control methods, the advantage of electronic implements must be either in their doing a job better than any other system, doing the same job cheaper than otherwise, or in making operable a process not heretofore possible. If the electronic device cannot do one or more of these improved operations, it will not be used. Especially important is it that we do not ascribe magical powers to an idea and scientific principle which is quite effective enough without supernatural powers.

Among the fields in which electronic devices excel is temperature measurement; recording and measurement of smoke densities; flow transmitter or indicator; pressure measurement, and some others. Automatic control appears to offer the greatest scope for the advantages of electronic methods. The advantages are zero input torque, limitless output torque to actuate equipment, a precision heretofore unknown, and high speed, the experts say.

Synthetic Rubber Views Its Future

SERIOUS consideration is being given to the prospects for the future of synthetic rubber, especially during the immediate postwar period. Annual rubber demand for the world during the first postwar years will be in excess of 1,500,000 long tons, says M. A. Brenner, of the National Planning Association. This association, according to its claims, is "a privately financed, nonprofit, nonpolitical organization . . . devoted to planning by Americans in agriculture, business, labor, and government."

During the postwar period synthetic rubber will not be able, probably, to compete with natural rubber, Brenner believes, although eventually it will compete on equal economic terms and on the basis of superior or equal qualities. Because of the buildup of demand during the lean war years, and the combination of natural and synthetic-rubber supplies immediately afterward—unless the Japanese entirely destroy the rubber forests in East Indies—these two sources will be able to supply a demand for at least 1,700,000 long tons the first postwar year and about 2,700,000 tons during the second year, Brenner states. After this excess demand is supplied and normal replacement and natural increase in requirements constitute the whole demand, synthetic rubber may find itself in difficulties. The main difficulty will be that of cost.

The association report believes that by diligent research the price disadvantage of GR-S (buna-S) rubber for tires may be overcome in the postwar period. The same is true potentially for the physical properties of GR-S in tires; important reductions in costs can be effected by careful development, as compared to the excessive costs of rubber from the high-priced plants and operations of the rush war period.

Specialty rubbers, such as buna-N (butadiene-acrylonitrile rubber), neoprene (chloroprene rubber), and Thiokol (alkyl sulfide rubbers) are expected to continue as most useful for specialties, better than natural rubber. Butyl rubber, highly impervious to the passage of gases, may prove superior to natural rubber, because of that property and extreme oxidation resistance.

The greatest factor in the equation is the attitude of the U. S. Government, and whether or not economic protection will be given the war-born industry.

Aerial Jet Propulsion a New-Old Development

JET propulsion of a vehicle, by the reaction of exploding and expanding gases against suitable portions of the vehicle, is not a war-born engineering miracle. Many engineers of many countries have been working on the design of such units for several years with varied success. The United States, Sweden, England, Switzerland, Italy, and Germany all have worked on the problem, and the recently press-agented rocket plane is doubtless some adaptation of some or many of these trial designs.

Few of these jet-propelling power plants are really rocket types. Some of them employ a more or less conventional engine with reciprocating pistons to operate a hot-air compression unit which in turn powers a turbine type. It is reported that these have shown no practical advantages whatever. The Swedish Milo turbo-compressive unit introduces air around a chamber in which fuel is burned with preceding air, to heat the incoming air and the combustion gases expand while passing out backward through an exit of diminishing cross-sectional area to a discharge nozzle, the forward reaction thrust pushing the vehicle, such as a plane, forward.

It is claimed that jet propulsion will be less critical of fuel qualities; safety fuels can be used without loss of efficiency; eliminates the handicap of the propeller; is better suited to high-altitude flying and therefore may be expected to power stratosphere and substratosphere postwar planes, if the jet engine can be perfected. Pressures are low, reducing weights of power plants.

MAINTENANCE EXPENSE OF INDIVIDUAL WELLS

THE accounting of maintenance expense incurred for the benefit of individual wells is an important factor in studying production expense and in reaching correct conclusions respecting action to be taken in lease operation. Many operators consider the lease as a producing unit and, consequently, are content to accept profit or loss figures on such without knowing the results of the operation, or being familiar with the characteristics of the individual wells that make up the unit. Production expense, or "lifting cost," of a lease is ordinarily divided between "operations" and "maintenance." Such items as fuel costs, pumpers' wages, treating expense and apportionment expense normally are considered to be operational accounts while repairs to surface and subsurface producing equipment constitute maintenance. Although a lease consistently may reflect a substantial operating profit, it is likely that some of the individual wells on the lease, because of high maintenance expense, do not contribute their proportion of the profit, or actually may be operating at a loss. In many cases, if a division of maintenance expense by individual wells is available, corrective measures may be applied that will put such wells on a more profitable basis thereby further increasing the profit of the lease unit. In order to have the needed information for complete individual well study, each well, in so far as repairs are concerned, must constitute a separate account. To each well the labor, material and services necessary for its maintenance is charged. The importance of an adequate system of reports that will make possible a picture of individual well maintenance should be recognized by every engineer.

As one illustration there is Lease "A" on which are eight wells. All produce about an equal quantity of oil and water. According to the operating statement the lease is a profitable unit and causes the management no particular concern. Revenue, after royalty payments, averages approximately $4,800 per month. Operating expense averages about $600, and maintenance, during a 12-month period just prior to the time an analysis was conducted, had averaged approximately $1,000 per month, leaving an operating profit, before taxes, of about $3,200 per month. Records showing maintenance expense allocated to the individual wells were examined and for the yearly period monthly averages were found to be as follows:

	Maintenance expense, average per month			
No. Well	Surface	Sub-surface Sub-	Total	Per cent of total Per cent
1	$25	$55	$80	7.9
2	32	78	110	10.9
3	30	68	98	9.7
4	179	51	230	22.8
5	41	63	104	10.3
6	37	228	265	26.3
7	20	43	63	6.3
8	28	30	58	5.8
Lease total	$392	$616	$1,008	100.0

From the figures above it was observed that equipment at Wells 4 and 6 had been more expensive to maintain. At Well 4 repairs to surface equipment had been excessive and at Well 6 subsurface repairs had been out of line. At this point in the analysis the expense records had served their primary purpose in that they had called to the engineer's, or analist's, attention specific wells that needed attention and showed him, in a general way, the type of expense that appeared out of line. The next service provided by the detailed records was to show a description and date of each repair job that was necessary. From a study of the individual jobs conclusions relative to the need for corrective measures were reached. In the illustration being made it was found that at Well 4 excessive pitman and pitman-bearing trouble, worn jack-post bearings and unusual wrist-pin expense had been experienced. An investigation showed the rig front to be misaligned and after corrective measures were applied, maintenance expense of surface equipment more nearly was comparable with the other wells on the lease. At Well 6 it was found that numerous pulling jobs had been necessary because of the frequent failure of the particular pump being used in the well. A sand condition, not occurring in the other wells on the lease, was found to exist. A study of this condition resulted in the installation of a pump designed to more nearly meet existing conditions which greatly improved pump performance and reduced the frequency of pulling jobs. In the handling of a large number of producing wells in the area it was not realized by the field operating personnel that the two wells had been causing unusual trouble and not until maintenance expense, by wells, was examined was it found that trouble of an exceptional nature existed. Corrective measures were simple and effective and resulted in a reduction of some $300 per month in lifting cost thereby increasing the profit of operation of the property by a comparable sum. Additionally, there was a substantial reduction in down time which decreased production lost. This, in turn, increased the revenue from the property.

In a complete analysis of well-maintenance expense the number of repair jobs, dates necessary, and a description of the work performed, with a record of equipment removed and installed are invaluable. As pointed out above, due to the fact that frequent repair jobs cause high maintenance expense, the cost figures merely serve as a "red flag" in calling to the operator's attention the need for detailed analysis. Once the jobs are analyzed, one familiar with oil-field equipment can draw rather definite conclusions regarding well conditions from the type of repairs that have been necessary. In some cases if a deficiency exists, it may possibly be detected because of the occurrence of small, inexpensive jobs and a correction may be made before a complete failure or extensive damage occurs. Where material, or equipment, is being tested its performance can be closely followed from the well-maintenance records. Such records lend themselves to mass test of various sizes, types, or makes, of equipment and help to make possible the formulation of a general equipment policy.

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Engineering Fundamentals

No. 136

A FEATURE OF THE OIL AND GAS JOURNAL

THINNING MUD WITH CHEMICALS

CHEMICAL treatment of drilling mud is generally for the purpose of decreasing the viscosity and reducing the filter rate. Such treatment is commonly called "thinning," and chemicals used for this purpose are often termed "thinners." These chemical thinners are deflocculating agents which cause a higher degree of dispersion of the colloidal particles in the mud. More complete dispersion of the particles, in turn, produce a thinner filter cake, lower water loss, and lower viscosity.

Rarely is it considered desirable to use chemical flocculating agents in drilling mud. At one time this practice was followed, since it made possible the attainment of a desired mud viscosity with a minimum amount of colloidal clay. At that time, this result was considered advantageous because it promoted a higher yield of mud per ton of bentonite and thus reduced the cost of a given volume of mud of the desired viscosity. Flocculating agents used for this purpose were lime, cement, and caustic soda. However, as mentioned earlier,* such treatment produces a very poor filter test. This practice was discontinued after the need for good filter properties was recognized.

Water can be used for thinning mud but such treatment has limitations. Dilution with water not only reduces the viscosity, but also reduces the density and may not appreciably improve the filter properties. In general, viscosity reduction by dilution with water can be practiced only when a proper combination of viscosity, density, and filter properties can be maintained. For example, if the viscosity is too high and reduction of density is not desirable, chemical thinners should be applied.

In drilling the shallower portion of a deep well it is often good practice to depend mainly on water thinning and use chemicals sparingly in order to avoid an overtreated condition of the mud when greater depths are reached where serious treating problems may arise. An additional advantage of using water rather than chemicals where conditions permit, lies in the economy that may be realized due to reduction in the total amount of chemical used in the mud.

Results obtained with chemical treatment vary greatly from one well to another; an effective treatment in one well may be entirely ineffective in another. For this reason, rules governing the use of any given chemical must be cautiously devised, and unwarranted conclusions must be avoided. Individual laboratory tests on the particular mud in question must usually be made in order to intelligently choose the best chemical and decide upon the best proportions.

A large number of chemicals have been used as deflocculating agents for the purpose of reducing viscosity and improving filter properties. The most effective chemicals that have been widely used for this purpose are listed and discussed below.

Sodium tannate.—Sodium hydroxide and tannic acid are mixed together to produce this treating agent. A crude form of tannic acid, called quebracho, is commonly used. The deflocculating action of this chemical is attributed to its being a protective colloid which is adsorbed as a coating on the clay particles and thus decreases and retards the attraction of the particles for each other. Before adding sodium tannate to a mud, it is advisable to measure the pH of the mud in order to determine the proper relative proportions of caustic (sodium hydroxide) and quebracho. If the pH is low, a higher proportion of caustic must be used in order to raise the pH. Lowering of pH may be accomplished by using little or no caustic along with quebracho. The protective action is furnished by the quebracho; while the principal purpose of the caustic is to allow regulation of pH value.

Sodium silicate.—This chemical is usually considered a flocculating agent, although it has been found that small proportions (below 1 per cent) will deflocculate most muds. Use of the chemical in too great a proportion will result in flocculation and the filter properties of the mud will become very poor. Therefore, care must be used to avoid overtreatment; this requires close laboratory control on each individual mud. Sodium metasilicate in small amounts may be used with tannic acid to counteract some of the acidity and, at the same time, aid in deflocculation. A special application of this chemical in the drilling of heaving shale will be discussed in a later part of this series.

Complex Phosphates

There are several phosphates which have been used as deflocculating agents in drilling-mud treatment. These include pyrophosphate, metaphosphates and tetraphosphates. These chemicals are prepared by dehydrating normal orthophosphates. Orthophosphates generally have a flocculating effect on drilling mud. For this reason, the deflocculation of mud by a pyro, meta, or tetraphosphate is temporary; that is, after the phosphate has been mixed with the mud it gradually hydrates, reverts to an orthophosphate, and produces flocculation. Maintenance of a deflocculated condition with these chemicals requires, then, repeated additions at intervals following the initial treatment.

Sodium hexametaphosphate is one of the most commonly used and effective deflocculating agents. Its use in connection with treatment for cement contamination has been discussed.* Treatment with this chemical is somewhat more expensive and less permanent than treatment with sodium tannate. Mud may be overtreated with sodium tannate so that further additions cause no effect; treatment with sodium hexametaphosphate may be applied to such mud.

Sodium pyrophosphate, sodium tetraphosphate, sodium tripolyphosphate, and sodium acidpyrophosphate all produce deflocculating effects when added in small proportions to the usual drilling mud. In general, all of these complex phosphates revert to orthophosphates after a period and produce flocculation. All of them produce flocculation if used in too high a concentration. Therefore, overtreatment by continued additions should be avoided. One reason for the popularity of the hexametaphosphate is that it can be used in relatively high concentrations without showing any harmful effects.

*See Installments 134 and 135.

*Installment 134.

Series prepared by Glenn M. Stearns, associate professor of petroleum engineering, University of Oklahoma

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VALVES

QUESTIONS on TECHNOLOGY

by W. L. Nelson

Pressure Drop in Box Condensers

Note: In connection with our item (p. 54, April 17, 1944) entitled "Pressure Drop in Condenser Box Headers," the pressure drop in the coils of the box was mentioned as the major cause of back pressure. The magnitude of the pressure drop in the coils of a box is discussed on this page.

The part of the box in which condensation takes place will cause a pressure drop that is one-third to one-half as much as it would cause if the entire condensing zone were operating at the inlet velocity. Thus, if a gas were flowing through 500 ft. of 2-in. pipe at a velocity of 100 ft. per second, it would cause a pressure drop of 5 × 2.51 (The Oil and Gas Journal, p. 90, Fig. 1, Mar. 30, 1944) or 12.55 lb. per sq. in. However, if total condensation occurred in the 500 ft., the pressure drop would be only about one-half as much, or 6.3 lb. per sq. in. (or perhaps as low as one-third as much or 4.2 lb.).

Thus, the estimation of pressure drop is simple except for difficulty in determining what part of the condenser box or what length of coil causes condensation and what part serves only to cool the condensed liquid. This is a computation which is different for each box and one that cannot be simplified into a generalized or tabulated form. This is particularly true if steam is condensed along with the petroleum vapor.

Development of Theory

The factor of one-third to one-half mentioned in the first paragraph can be derived by the use of calculus. If the amount of heat removed per foot of length is considered to be constant, if the specific gravity is considered to be that of the vapor, and if the friction factor in Fanning's pressure-loss equation for turbulent flow is assumed to be a constant, the loss in pressure may be stated as

$$\Delta P = \frac{0.323\ fsL_t}{D} u^2_{ave} = \frac{0.323\ fs}{D} \int_0^{L_t} u^2\, dL$$

For an inlet velocity of u_1 and an outlet length of L_t, the relation of the velocity u at any length L, is

$$L = L_t - L_t \frac{u}{u_1} \text{ or } dL = O - \frac{L_t}{u_1} du$$

$$u^2_{ave}\ L_t = \frac{L_t}{u_1} \int_{u_1}^{0} u^2 du$$

$$u^2_{ave} = \frac{1}{u_1} \left[\frac{u^3}{3} \right]_{u_1}^{0} = \frac{u_1^2}{3}$$

Or for a length (L_t) of pipe in which complete condensation takes place at a uniform rate:

$$\Delta P = \frac{1}{3} \frac{0.323\ fsu_1^2 L_t}{D}$$

The symbols used are:

ΔP = pressure drop, in lb. per sq. in.
f = friction factor in Fanning's equation, a function of Reynolds Criterion
s = specific gravity of inlet vapor
D = diameter, inches
L_t = total length of pipe or tubing
u_1 = inlet velocity, ft. per sec.

Thus for these assumptions, the pressure drop in a condensing zone is exactly one-third of the pressure drop caused by a similar zone in which no condensation takes place.

The assumption that the heat removed per foot of length is a constant, is not entirely satisfactory. The effectiveness of a foot of coil becomes less and less as the velocity decreases. This is due partly to a decrease in the temperature difference between the coil and the cooling water but it is due also to a decrease in the heat-transfer rate. The exact magnitude of these factors is a function of the particular conditions, and hence it can only be stated that the pressure drop through a zone in which total condensation takes place is less than one-third as much as would occur if no condensation took place. Only in rare cases will the factor be less than one-fourth—those cases in which final condensation takes place at a temperature very close to the cooling-water temperature.

The second assumption, i.e., that the specific gravity of the fluid is the same as that of the gas, is doubtful. If the liquid drops out of the vapor stream and thereafter flows under its own propulsion along the bottom of the pipe, then the specific gravity of the fluid will be that of the vapor. If, however, the condensed liquid remains suspended in the stream of fluid, the specific gravity would be an average value which is a function of velocity. This may be evaluated as follows:

$$\Delta P = \frac{0.323\ f\ L_t\ su_1}{D} \int_0^{L_t} u\, dL$$

$$\Delta P = \frac{1}{2} \frac{0.323\ f\ su_1^2 L_t}{D}$$

If this is indeed the situation, the pressure drop in a condensing zone will be one-half rather than one-third of the pressure drop caused by a similar zone in which no condensation takes place.

The assumption that the friction factor is a constant cannot be easily evaluated. For pipe sizes ranging from 1 to 16 in. in diameter and for inlet vapor velocities ranging from 20 to 200 ft. per second, the friction factor of the outlet material (liquid) is larger than those of the inlet vapor by multipliers of the magnitude of 1.33 to 2.63. Thus, the plain arithmetic average of the friction factor in the condensing zone would range from about 1.16 to 1.87 times as large as the inlet friction factor, but it would seem that the true average friction factor would be even smaller because of the logarithmic nature of the relationship between velocity and friction factor. When considering the common ranges of pipe size (4 to 16 in.) and of velocity (50-150 ft. per second), it seems that the effect of a varying friction factor would cause an increase in pressure drop of 10 to 25 per cent.

A consideration of all of these considerations indicates that the pressure drop in a condensing zone will in no case be less than one-fourth nor greater than five-eighths of what the pressure drop would be in a similar length of pipe in which no condensation took place. In nearly all situations the pressure drop will fall in the range of one-third to one-half.

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CONTINENTAL

REFINING

Plant to Have Big Medical And Personnel Building

BATON ROUGE, La. — Work has started on construction of a big medical and personnel building at the Standard Oil Co. of Louisiana's refinery here. The main building, a combination one and two-story structure, will house the various departments of the medical and personnel divisions, along with the office of the timekeeping and recording department. On one side of the pylons bordering the entrance will be a clockhouse and salesroom for employes, and on the other a police house, with a customs office.

In the upstairs portion of the main building, which will front on the Scenic Highway, will be the offices of W. P. Reymond, Jr., personnel manager, and his assistants, also the offices of the safety and training departments, in charge of A. J. Ferguson and T. S. Keaty, respectively. On the same floor will be a large assembly hall, conference and training rooms, plus offices for the department assistants and clerical personnel.

The medical department of which Dr. C. E. Allen is director, will occupy the one-story portion of the main building. In this section will be doctors' offices and consultation rooms.

Esso Research Club Becomes Sigma Xi Chapter

NEW YORK. — The Esso Research Club recently became the first industrial organization to become a formally chartered chapter of Sigma Xi, national scientific honor organization. Participating at the presentation of the charter were Wallace E. Pratt, vice president and director, Standard Oil Co. (N. J.); Minor C. K. Jones, retiring club chairman; Harlow Shapley, national president Sigma Xi, and Ejnar Carlson, chairman-elect of the club. Dr. Jones is head of the gasoline-fuels group, process division, and Carlson is a laboratory technologist.

Cooperative 100-Octane Plant Goes on Stream

NORTH KANSAS CITY.—The federal Government's $6,000,000 aviation gasoline refinery at Coffeyville, Kans., went on stream at 3 a.m., May 11, it is announced by Howard A. Cowden, president of the Cooperative Refinery Association here, which will operate the plant for the duration. At that time charge oil was run to the fluid catalytic cracking unit culminating 20 months of construction effort. Ground for the project was broken on September 19, 1942. W. H. Humphreys is superintendent of the plant.

Lt. Comdr. Henry H. Fox, Jr., of the U. S. Navy assigned to the Petroleum Administration for War, was in Coffeyville when the catalytic cracker was placed in operation. He said the next step is to produce maximum quantities of 100-octane gasoline to service bombers and fighters of the United Nations.

Gulf Coast Independents Operating at High Rate

HOUSTON.—Total crude throughput of 111,705 bbl. daily, an increase of 27,100 bbl. over that of a year ago, is reported by the 11 independent operating companies in Gulf Coast Refiners Association in their statement covering the second half of April. Current charging rate is 92 per cent of rated capacity, compared with 58 per cent in April 1943, when this refining area was restricted as to throughput and yields of gasoline Gasoline stocks continue at low levels.

Stocks of all grades of gasoline were 1,276,625 bbl., an 82,879-bbl. decrease in 2 weeks. A year ago gasoline stocks held by the GCRA group totaled 2,468,313 bbl., roughly 1,200,000 bbl. more than now held. Of motor gasoline for automotive use the group reported 595,177 bbl., only half as much as was held last year. From the current low stocks must be deducted special military gasoline, over one-fifth of the total, leaving automotive gasoline stocks available for civilian use at the lowest level during the past 5 years.

Kerosene stocks at 139,975 bbl. May 1 show little change. Diesel gas-oil stocks May 1 were 79,456 bbl., a 42,896-bbl. increase for the 2 weeks, attributed to an additional refinery starting manufacture of this product. Stocks of the various grades of gas oil dropped from 1,055,335 bbl. on April 15 to 884,673 bbl. May 1. Stocks of heavier fuels continue low with No. 5 fuel oil at 236,610 bbl. and bunker C fuel oil at 391,730 bbl. Cut-

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back asphalt was 45,792 bbl., showing no change.

Total stocks of all products was reported at 3,182,692 bbl. May 1, a decrease of 206,939 bbl. during the second half of April. This compared with total stocks a year ago of 4,126,149 bbl.

Government Officials Take Part in Plant Dedication

GALVESTON, Tex. — Representatives of the Army, Navy, Marines, and Coast Guard took part May 12 in ceremonies dedicating the 100-octane gasoline plant of Southport Petroleum Co. of Delaware at Texas City. Bruce K. Brown, assistant petroleum administrator, gave the principal address. W. V. McBride, vice president of Oil Workers International Union, spoke as a representative of labor. Sen. Joe L. Hill, vice president of Southport, was master of ceremonies.

Greetings were read from Secretary of the Navy James Forrestal, Undersecretary of War Patterson, Secretary of Commerce Jesse H. Jones and other government officials.

V. E. Smith is refinery superintendent. The Southport unit, which went on stream January 24, is the first 100-octane plant built for Defense Plant Corp. and the first to produce finished 100-octane gasoline from a catalytic cracker and alkylation unit. Associated with Southport Co. are American Liberty Oil Co. and Talco Asphalt & Refining Co.

United States and Caribbean refiners are supplying 88 per cent of the 100-octane gasoline used by the United Nations, which has reached the staggering figure of 400,000 bbl. daily.

Sketches of Plant Operators

HOMER AMBROSIER, superintendent of Union Oil Co.'s Maltha refinery, near Bakersfield, in Kern County, California, joined the company March 30, 1911, as a roustabout at the Oleum refinery when he was 23. The supposedly temporary job proved permanent, and he recently completed 33 years of uninterrupted service.

In October 1917 Ambrosier was appointed a stillman at Oleum refinery, and in November 1918 he was advanced to night refinery foreman. In succession he held positions as day foreman, subforeman, refinery foreman, and day refinery foreman. In May 1926 he was transferred to the Maltha refinery as assistant superintendent. He was appointed superintendent in January 1927.

The plant at Maltha has been remodeled since Ambrosier became superintendent and at present it is making only aviation gasoline and other products exclusively for the armed forces. Ambrosier was born May 5, 1888, in Kellerton, Ringold County, Iowa, and is married.

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In the Refinery: In the Oil Field

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PIPE LINES

Pan American Prepares For Port Isabel Line

The Pan American Pipe Line Co. has started its survey, pipe has been shipped and bids are in the hands of contractors for the construction of a crude-oil line from the Willamar field in Willacy County, Texas, to Port Isabel, at which point arrangements have been made for terminal facilities for the loading of Willamar crude on seagoing tankers.

The line will be approximately 34 miles of 8⅝-in. seamless steel pipe, protected from corrosion by the application of asphalt with bonded felt. A telephone line will parallel the oil line.

The initial capacity will be approximately 10,000 bbl. per day, which can be increased to the estimated ultimate capacity of the field to produce, through the installation of additional units. Pumping equipment will consist of the primary station in the Willamar field, using reciprocating pumps and automotive type prime movers. The line will be served by an adequate gathering system, having four field gathering stations, covering the entire productive area that is presently approximately 3 miles wide and 5 miles long.

The Pan American Production Co. purchases the crude produced at Willamar and is the major operator in the field, in which 24 producers have been completed and 12 wells are now drilling.

WEP Ships Test Batch Of 100-Octane Gasoline

A test batch consisting of 275,000 bbl. of 100-octane gasoline has been moving eastward during the past week through the War Emergency Pipe Lines, Inc. 20-in. products line. If the transportation of this batch proves to be acceptable, it is reported that the operating schedule for the line may be modified to provide for handling such shipments in the future.

No plugs or scrapers are used for the purpose of separating batches going through the line because the established method of modern products pipe lining has proved adequate for requirements. Intermingling between batches is reduced to a minimum by maintaining sufficiently high pressure in the line. Present practice of WEP in the operation of the products line is to use plugs only with batches of heating oil. These plugs are run midway in heating oil batches where they function for cleaning the line only and not for separating shipments.

Shipments are moving through the WEP 20-in. products line at the rate of 175,000 to 180,000 bbl. daily. Throughput for May has been scheduled for movement of products at the following daily rates: 80-octane gasoline, 45,000 bbl.; housebrand 72-octane gasoline, 28,000 bbl.; Navy diesel fuel oil, 35,000 bbl.; No. 2 heating oil, 72,000 bbl. During the coming months a marked decline is expected in heating-oil shipments together with an increase in movement of other products.

Work is being completed for installing the two pumping units of WEP 24-in. crude-oil line transferred with the abandonment of Station 9b, Gale, Ill., for permanent service at Station 9, Oran, Mo. The first of the two units was in operation last week; the second started this week. During the transfer, throughput could be maintained at approximately 260,000 bbl. daily by operating the one unit at Oran at a high suction pressure. One day while manifold work was being done during the transfer operations, throughput dropped to 228,000 bbl. daily because of the time taken for shutdown. Crude shipments are now moving at usual rates of 305,000 to 310,000 bbl. daily.

Contracts to Be Let Soon for Pipe Lines

Within the next few weeks contracts are to be let for a substantial amount of pipe-line construction to be conducted during the summer on several projects.

Contracts for three spreads to lay 240 miles of 12-in. for Stanolind Pipe Line Co. crude oil from Elk Basin to Casper, Wyo., are expected to be let this week. Surveys are proceeding and work will start in the middle of June for this undertaking scheduled for completion in September. Present plans call for the building of only one pump station which will be equipped for electric operation. The line will be coated and wrapped for its entire length.

Panhandle Eastern Pipe Line Co. is reported to be preparing to let contract within a week for the laying of a 32-mile 22-in. loop in the Texas and

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Early this week Pan American Pipe Line Co. was preparing for the letting of a contract for the 34-mile 8-in. crude oil line from the Willamar field to Port Isabel, Tex., described in another news item on these pages.

Hope Natural Gas Co. and New York State Natural Gas Corp. are expected to contract within the next few weeks for construction this summer of 150 miles of 12-in. from Wetzel County, West Virginia, to Clarion County, Pennsylvania, to be handled by four spreads.

Northern Natural Gas Co. has been considering plans for construction this year of 9 miles of 24-in., 1 mile of 18-in. and approximately 5 miles of 4-in. and 6-in. gathering lines in the vicinity of Skellytown, Tex.

Magnolia to Increase Throughput of New Line

Magnolia Pipe Line Co., according to reports, plans to assign some of the pumping equipment from its 8-in. line from Midland to Corsicana to its new 12-in. system. This will increase capacity of the latter from 42,000 to 55,000 bbl. daily and reduce the former from 29,000 to 16,000 bbl. daily. This is being done in order to use the old line for the exclusive movement of sweet crude and raise throughput of the new line.

Gulf Completes Looping For West Texas Outlet

Looping of the Gulf Refining Co. pipe-line system from West Texas to Weatherford, Tex., has been completed. Through the looping of sections of the system, Gulf now has two 10-in. lines from West Texas to Weatherford. At the latter point, some of the oil is pumped through an 8-in. system to Saltillo, Tex., then to Big Sandy and Longview, Tex., where it goes into the War Emergency Pipelines, Inc., crude-oil system.

The looping of the line gives the Gulf company a maximum capacity of approximately 90,000 bbl. out of West Texas, an increase of 15,000.

Sinclair Plans Outlet For Wyoming Fields

The War Production Board's regional headquarters at Denver, Colo., has announced approval of a recommendation of Sinclair Refining Co. to lay a pipe line extending from Lost Soldier and Wertz fields, Wyoming, to its refinery at Sinclair, Wyo., at a cost of $210,394.

Panel Instrument Deliveries Accelerated

The panel indicating instrument industry is now in a position to fill orders for any known requirements for these instruments, representatives of the War Production Board announced at a recent meeting of the Panel Instrument Industry Advisory Committee. Electrical panel indicating instruments are instruments for panel or switchboard mounting normally connected to a circuit for continual measurement.

Quotations on delivery time for panel indicating instruments have been reduced within the past 6 months, WPB said. While quotations formerly were for delivery from 6 to 8 months after receipt of an order by an instrument manufacturer, the average delivery time is now 4 months. This is only one month more than the average procurement time of 90 days experienced by instrument manufacturers in purchasing necessary materials. Under certain conditions, WPB representatives said, delivery can even be made in 30 to 60 days after receipt of an order for standard panel types.

Colonial Beacon Abandons Massachusetts Project

After a considerable amount of planning and negotiating, Colonial Beacon Oil Co. is reported to have abandoned the project for a 34-mile 4-in. and 6.-in. products pipe line from Everett in the Boston metropolitan district to Methuen, Mass. The project had to be given up because of difficulties in obtaining right-of-way.

Large Projects Considered As Hugoton Field Outlets

Within a year it is predicted that important pipe-line construction will be undertaken to provide for transmission from Hugoton field, now regarded as the largest natural-gas reservoir in the world. The first pipe line, for which an Federal Power Commission permit has been requested is the 215-mile 18-in. line proposed by Consolidated Gas Corp., affiliate of Electric Bond & Share Co., to extend from the Stevens County, Kansas, section of the field to Wichita, Kan. Its cost is estimated at $4,996,190.

Phillips Petroleum Co. is said to be considering several plans for transmitting gas from the Hugoton field. One project being studied, a 24-in. or 26-in. line from the field to Wichita, Kan., and Kansas City, would cost $20,000,000. Pacific Lighting Co. is planning a 950 to 1,000-mile 26-in. line from Hugoton to Riverside, Calif.

Okmulgee-Seminole Line Is Being Salvaged

A line formerly operated by Empire Pipeline Co. for moving crude oil has been sold to Goldenstern Pipe & Supply Co.; it is now being removed from the ground by A. C. Holder Construction Co. The line extends from Okmulgee to Seminole, Okla., and has consisted of 27 miles of 4-in. and 35 miles of 6-in.

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Exploration and Drilling

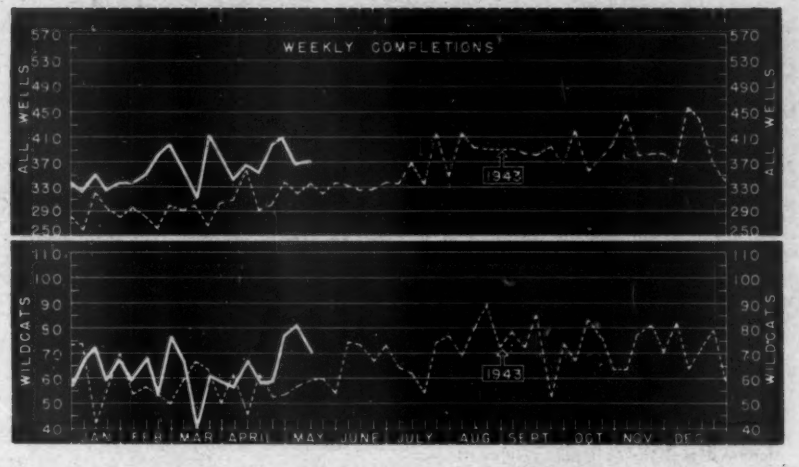
Week's Highlights

WHAT makes a wildcat wild?" may sound like a facetious question to the general public, but in substance, just that question has been the subject of serious study by a number of committees of top notch oil men for the past year. The question of how to classify exploratory wells was considered so important that the final decision and report was made by none less than that aristocracy of oil brains and executive ability, the Petroleum Industry War Council. There were very good reasons why these top executives of the industry devoted their valuable time to this subject.

The industry has several billion dollars invested in pipe lines, refineries, terminals and distribution facilities. That investment depends on an ample supply of the raw material, crude oil, to be transported to refineries, processed into finished products, and the products in turn distributed to the public. But while the entire financial structure rests on a foundation of crude oil supply, oil fields are essentially one-crop farms and the supply of oil must be constantly replenished by finding new fields. It therefore becomes vital to know just what is the status of finding new fields at any given time, and how this condition compares with the past, or how it compares with the new supply required to meet current and near future demands.

To achieve this goal required the agreement of the industry on definitions and classifications of various types of exploratory wells. The men who served on the various regional committees, under the able leadership of Dr. F. H. Lahee, knew the practical problems in deciding whether a well was an extension, a new field opener, a discovery of a new shallow or a new deep sand in an existing pool, etc., etc. The definitions finally agreed upon are as near perfection as experienced, practical oil men can make them, considering the complex problem.

For the first time the industry has a standard set of classifications and a standard set of definitions, by which they can label any given exploratory well. This is a tremendously valuable tool. The next step is to see to it that the tool is used by the men on whom the final responsibility rests, the scouts.



Solid line charts current weekly completions

COMPLETIONS IN ALL FIELDS . . .

(Week ended May 13, 1944)

	Oil	Gas	Dry	Total	Footage	Total Comp. to date 1944	1943
N. Y., Penna., W. Va.	36	20	7	57	109,718	1,166	1,159
Ohio	1	8	4	13	38,060	321	275
Indiana	1	0	2	3	6,277	82	87
Kentucky	5	0	2	7	13,831	215	115
Illinois	11	0	20	31	81,646	572	646
Michigan	5	1	10	16	38,912	200	156
Kansas	15	1	20	36	125,188	815	529
Nebraska	0	0	0	0	0	8	9
Missouri-Iowa	0	0	0	0	0	5	4
Oklahoma	17	1	11	29	103,615	553	397
Texas:							
North Central Texas	8	0	5	13	34,339	501	444
West Texas	16	0	7	23	108,182	539	310
Texas Panhandle	5	0	0	5	15,560	61	64
Eastern Texas	2	2	3	7	51,881	112	92
Texas Gulf Coast	15	4	3	22	148,866	311	143
Southwest Texas	7	1	7	15	72,176	273	306
Total Texas	53	7	25	85	431,004	1,797	1,362
Louisiana:							
North Louisiana	3	0	4	7	19,112	99	110
Louisiana Gulf Coast	12	4	5	21	193,396	160	117
Total Louisiana	15	4	9	28	212,508	259	227
Arkansas	1	0	1	2	7,302	78	86
Mississippi and Southeast	0	0	3	3	18,416	51	26
Montana	4	0	1	5	13,500	86	62
Wyoming	5	0	1	6	30,329	57	42
Colorado-Utah	0	0	0	0	0	11	5
New Mexico	8	1	4	13	37,913	146	76
California	36	0	4	40	126,800	691	435
Total United States	207	43	124	374	1,395,019	6,913	5,695
Total previous week	203	32	128	363			
Week ended May 15, 1943	202	26	111	339			

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ROCKY MOUNTAIN

Stanolind Opens Pool on Cooper Cove Structure

DENVER. — Stanolind Oil & Gas Co. 1 Johnson-Parkinson, SE NE SW 30-18n-77w, opened a new oil pool on the Cooper Cove structure, a narrow anticline at the southern end of the Rock River fold, on the line between Carbon and Albany counties, southern Wyoming. After finding water in the Sundance at 5,373 ft., it was plugged back to the Dakota and completed for 282 bbl. in 20 hours on a swabbing test. At the end of the period it was flowing 6 bbl. an hour.

Honolulu to drill Fourbear.—Honolulu Oil Corp. is getting ready to drill on the Fourbear anticline in Park County, Wyoming, this season after making a heavy oil Tensleep discovery 16 years ago. It has since been produced only for exploratory purposes. The structure is about 20 miles southwest of Oregon Basin, an anticline approximately 8 miles long with several highs.

Powder Wash oil horizon extended.—The Mountain Fuel Supply Co. 2 Allen, SE NE NW, 32-12n-97w, Powder Wash field, Moffat County, northwestern Colorado, completed in 1942 as a gas well at 4,006 ft., has been deepened to 5,150 ft. and recompleted in sand in the Wasatch formation at 5,061-5,110 ft. for 184 bbl. in the first 24 hours. Location is ¾ mile north of 1 Stewart and 1 Allen, both of which are oil producers.

Renewed activity in Grass Creek.—Grass Creek, in which 14 wells have been drilled to the Embar-Tensleep, is showing signs of renewed activity in the deep horizons. Ohio Oil Co. has three operations under way and Stanolind Oil & Gas Co. is starting another. Husky Refining Co. has made a location for 1 Kinney-Coastal in SE SW 20-46n-98w, an outpost ¾ mile southeast of the nearest Embar-Tensleep producer.

South Garland test. — Mackinnie Oil & Drilling Co. has made location for 1 Sheridan Milling Co., NE cor. Lot 43-C-55n-97w, in a fault block at the south end of the Garland structure. The new test will disclose whether the faults continue down to the Tensleep or whether a shallow pay, recently proven for oil on the flanks in two wells, blankets the entire field.

WYOMING WILDCAT COMPLETIONS

Carbon County: Stanolind Oil & Gas 1 Johnson-Parkinson, SE NE SW 20-18n-77w, flowing 6 bbl. per hour from Dakota at 4,834-4,912 ft., PB from original TD 5,373 ft., Frontier 4,075 ft., Dakota 4,834 ft., Lakota 4,931 ft., Sundance 5,280 ft., found water in Sundance 5,280-5,304 ft. Cooper Cove discovery well.

Park County:: Stanolind Oil & Gas 1 Garth, NE NE NE 26-58n-100w, dry, TD 6,808 ft., Tensleep 6,140 ft.

CALIFORNIA

Two Tests Under Way In Imperial County

LOS ANGELES.—Two wildcats are under way near Truckhaven and San Felipe in Imperial County. Pure Oil Co. is drilling in 26-10s-9e, and Standard Oil Co. of California has a test under way in 27-11s-9e. These two wildcats are approximately 6 miles apart. Standard's wildcat is located on a block of about 10,000 acres approximately 15 miles west of the Salton Sea, midway between Indio and Brawley and about 100 miles northeasterly of San Diego.

In the Buena Vista Hills field, Standard cored the deep zone in its second well at 3,680 ft. and on a formation test at 3,680-735 ft. the well flowed clean gassy 31.7-gravity oil and gas for 3 minutes, the duration of the test. Drill-pipe recovery was 250 ft. of clean oil and plans were immediately started to complete the well. This hole is located a little over ½ mile north of the discovery well and its completion would prove up at least one section of land. Standard's third well at Buena Vista Hills, located along the west side of the same section, 27-31s-23e, has just passed 3,000 ft. and still has some distance to go before hitting the pay.

M. Metzenbaum's outpost in the Tejon district of southern Kern County which blew out early last week has been temporarily shut down pending the moving in of a mast to facilitate swabbing operations. In order to kill the heavy gas pressure, the operator was obliged to circulate 90-lb. mud all night and this appears to have effectively mudded the hole. After the portable equipment had been removed, due to commitments elsewhere, Metzenbaum circulated crude oil in the hope of getting the well to kick over but it failed to respond.

CALIFORNIA WILDCAT OPERATIONS

Kern Bluff wildcat district, Kern County: Standard 4-8-27 fee, 27-29s-29e, abandoned in gray sand, TD 1,457 ft.

Los Banos wildcat district, Merced County: Obispo Oil Co. and Brookline Co. 1 Stone, 1-12s-11e, abandoned in hard gray sand, TD 5,050 ft.

Stockton wildcat district, San Joaquin County: Richfield 2 East Stockton, 6-1n-9e, abandoned in basement conglomerate, TD 6,376 ft., wet on test 6,050-90 ft., basement 6,340-76 ft.

N. CENTRAL TEXAS

Strawn Sand Pool Opened In Western Clay County

WICHITA FALLS.—Bridwell Oil Co. 1 J. S. Bridwell River Ranch, Lot 27, Word and Halsell subdivision, 8 miles northeast of Scotland and 3 miles west of Halsell pool, kicked off and was flowing oil estimated at 400 bbl. per day, from Strawn sand at 4,745-70 ft., total depth. A south offset to the strike has been staked in northwest corner Lot 40, Word and Halsell subdivision. Third completion for the new Bellevue Mississippi lime pool seen at Sinclair Prairie Oil Co. 2 Emma Spikes, total depth 6,402 ft., which topped Mississippi lime at 6,149 ft., showing oil from 6,170-6,410 ft. A drill-stem test at 6,257-6,402 ft. showed gas in 14 minutes. The well will be perforated for completion. Lacy and Flannery 1 M. M. Lyles, Block 21, San Augustin University Survey, 12 miles southwest of Henrietta, which has been shut down for some time waiting on pumping equipment, reported finding hole full of oil when rigging up pump. It had been perforated at 5,610-25 ft. and acidized with 6,000 gal.

Jack County.—Another Caddo lime producer for the Ellis Strawn sand pool was seen at Hanlon-Buchanan 8-B Ellis & DuBose, J. W. Williams Survey, which showed oil in Caddo lime at 4,772-96 ft., total depth, and set casing at 4,772 ft. after running electric log. Shell Oil Co., Inc. 1-B O. J. Lester, north offset to Mississippi lime discovery in McKinney & Williams Survey, 5 miles northwest of Jacksboro, had dry Ellenburger at 5,695 ft., total depth 5,744 ft., and was plugging back to test the Mississippi lime.

Cooke County.—Northern Ordnance 1 John Ware, William Goodnight Survey, 2½ miles southeast of Woodbine and 1½ miles southeast of Woodbine Strawn sand pool, was proceeding to the Ellenburger after showing salt water on drill-stem test at 4,603-10 ft. Sinclair Prairie Oil Co. J. H. Cory, northwest offset to Strawn sand discovery northwest of Walnut Bend, was drilled to 6,223 ft., showing 185 ft. oil-cut mud on drill-stem tet from 6,090-6,120 ft. The test will likely be plugged back to 5,880 ft. for completion attempt in lower Strawn sand. Magnolia Petroleum Co. 1 Sallie Long, north offset to discovery, was abandoned at total depth 5,968 ft. after showing only mud on test through perforations at 4,634 ft.

Montague County.—Further west extension for the Hildreth pool was indicated at F. L. Boutell 2 J. L. Brown, total depth 6,350 ft., and casing will be perforated for completion.

NORTH TEXAS WILDCAT COMPLETIONS

Archer County: Fortex Oil 1 W. P. Fergu-

DAILY AVERAGE PRODUCTION FOR WEEK

	May 13 crude oil	Distillate, allied products	May PAW quota all oils	May 6 crude oil
Arkansas	80,300	5,000	81,700	79,900
California	831,600	46,500	886,500	825,800
Colorado	7,950	.....	7,200	7,800
Eastern	72,000	8,600	82,400	74,100
Illinois	204,100	13,500	233,500	220,700
Indiana	14,100	.....	14,000	13,800
Kansas	278,000	5,800	290,800	267,200
Kentucky	22,750	2,700	25,700	22,800
Louisiana	357,900	45,000	395,000	358,200
North Louisiana	74,800	.....	.....	75,100
Louisiana Gulf	283,100	.....	.....	283,100
Michigan	52,100	300	54,300	51,950
Mississippi	41,100	.....	43,000	41,600
Montana	20,600	300	24,700	27,250
Nebraska	950	.....	900	1,000
New Mexico	111,800	4,900	116,600	111,800
Oklahoma	333,500	28,000	358,000	335,550
Texas	1,995,200	131,000	2,103,000	1,995,300
East Texas	364,100	.....	.....	364,100
West Texas	429,300	.....	.....	429,150
North Central Texas	147,200	.....	.....	147,200
East Central Texas	137,150	.....	.....	136,950
Texas Panhandle	90,900	.....	.....	91,000
Texas Gulf	720,100	.....	.....	730,650
Southwest Texas	96,450	.....	.....	96,250
Wyoming	87,650	7,200	101,200	94,100
Total United States	4,511,600	298,800	4,818,500	4,528,850
Total production January 1-May 13, 1944				591,482,111 bbl.
Same period last year				518,231,490 bbl.

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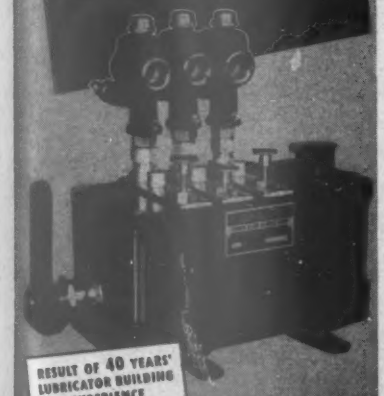

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son, 330 ft. from N, 800 ft. from W, Sec. 9, KWVFL subd., dry, TD 1,855 ft.

WEST CENTRAL TEXAS

ABILENE.—The Williams pool of northwest Coleman County was extended ¼ mile south by Hunter & Hunter 1-C Williams, NE NW NW Section 14, Block 2, T&NO Ry. Survey, flowing 869 bbl. oil per day from Gray sand pay 3,755-3,807 ft. This well is south of the B-1 Williams, which was the first flush producer for the area, gaging 880 bbl. per day, while the discovery well, ¼ mile east of B-1, made only 15 bbl. per day. The Hardy pool of north central Jones County was favored with another good well at Great Lakes Carbon Co. 3 Hardy, Section 11, Block 4 H&TC Ry. Survey, which made 175 bbl. per day from Canyon sand pay 3,707-13 ft. This is the fourth producer for the pool, and rig has been moved one location north of No. 2 Hardy for No. 4. Two wildcats have been staked in Jones County. Two and one-half miles southwest of Stamford, Geophysical Surveys, Inc. 1 A. A. Gustafson will be a Palo Pinto test, in SW NW NE Section 8, Block 4, H&TC Ry. Survey, while in the south edge of the county, Thomas D. Humphrey 1 A. John is located in Section 51, Block 16, T&P Ry. Survey, 2½ miles southwest of Sayles pool. An Ellenburger test for Shackelford County is Shell Oil 1 T. W. Lee, Section 50, William Woodward Survey, 2 miles southwest of Albany, and 15 miles west of new Ellenburger production in western Stephens County.

WEST CENTRAL TEXAS WILDCAT COMPLETIONS

Callahan County: B. C. Mann 1 B. C. Mann, 660 ft. from S and E, 177½-ac. lease, Wyatt Hickman Sur., dry, TD 1,885 ft.

Stephens County: Beacon Oil & Refining 1 Quincy Corbett, Sec. 1070, SPRR Sur., dry, TD 4,005 ft.

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SOUTHWEST TEXAS

New Producing Area Indicated in Nueces

CORPUS CHRISTI.—About 1½ miles northeast of southeast flank production in the Agua Dulce area, Nueces County, H. B. Smith 1 Rivers estate is reported showing enough on a drill-stem test to indicate opening of a new producing area. A test was made at 7,197-7,209 ft., with total depth 7,215 ft., recovering about 900 ft. of 38-gravity pipe-line oil. Using ¼-in. chokes it built up 90 lb. working pressure during the 15 minutes it was open and showed bottom-hole pressure of 1,200 lb. flowing and 2,900 lb. shut in. Operators plan to take two more 3-ft. cores and then run casing to bottom. About 6 miles east of Sandia in Nueces County, Hewitt & Dougherty have announced location for 1 Clara Bluntzeron, a 328-acre lease in the east half of Share 5, Bluntzer Partition of the Montemayor grant. It will be taken to a depth of 6,500 ft.

Humble Oil & Refining Co. has set casing in its 1 Sauz Ranch, north outpost in the Willamar area, recently reported as almost certain to extend the field a mile to the north. It had been taken to a total depth of 8,022 ft. in shale following the three drill-stem tests showing oil already mentioned.

Edwin M. Jones has set casing just below 7,000 ft. in his 2-C Ezzell, wildcat located 4 miles southeast of the Ezzell field, McMullen County. Total depth is 7,264 ft. This well has reported sand from 6,889-6,929 ft., with gas in the bottom and oil shows in the top, also some water sand below, all in the Carrizo-Wilcox section. On a drill-stem test at 6,892-6,901 ft. it showed some water-white distillate and lots of gas.

Atlantic Refining Co. 1 Atkinson, deep test in the Alta Mesa field which had drilled to 7,185 ft. and set casing at 7,143 ft., has made a squeeze job following the first test through perforations at 6,873-76 ft. where it showed some salt water. It had shown some distillate on a test at 6,851-61 ft. while the well was drilling and before setting casing.

Northern Ordnance Co. has made location for 1 H. M. Rushhaupt, new test in the Mission Valley area, where it recently opened a condensate field from the Wilcox formation below 8,400 ft. The new test to be in the Eben Haben Survey, a mile north of Mission Valley, Victoria County. Earlier the company had made location for 1 Schaeffer, in the W. T. Eaton Survey, about 2 miles northwesterly from Mission Valley, as another wildcat test. Both have announced intent to drill to 12,500 ft. The discovery at Mission Valley had been drilled to below 10,000 ft.

Seaboard Oil Corp. is building roads to move in to a wildcat 4 miles southwest of Dime Box in Lee County. The new test, 1 R. R. Beaman, located in the John B. Taylor Survey, is situated on a block of approximately 22,000 acres.

Moore Development Co. and Slick Oil Co. are making location for 2 Clara Briam, new wildcat about 2 miles south of Oakville in Live Oak County.

SOUTH AND SOUTHWEST TEXAS WILDCAT COMPLETIONS

Brooks County: Sun Oil 1-B Mary M. Lasater, Gyp Hill area, 6 mi. SE of Falfurrias in GB&CNG RR Sur. 331, dry, TD 6,767 ft.

Duval County: J. W. Gorman 2-B W. K. Hoffman, about 7½ mi. SE of Freer, in BS&F Sur. 116, dry, TD 2,253 ft.

Argo Oil 2 Gertrudis C. Canales, Jose Marcelo Hinojosa grant, 1½ mi. E of Crestonio, dry, TD 5,310 ft.

Jim Hogg County: Arkansas Fuel Oil 2 L. J. Spoonts, 5 mi. SE of Weil field, Jose Manuel Ramirez grant, dry, TD 5,015 ft.

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Standard Oil Co. 1 E. G. Canales, NE cor. of county, 7 mi. NE of Hebbronville, Jose Marcello Hinojosa grant, TD 5,805 ft., PB to 5,116 ft., perf. 5,102-12 ft., pumped 18 bbl. day, 43.1-gravity, no water.

EASTERN TEXAS

Smackover Wildcat Staked In Bowie County

DALLAS.—Barnsdall Oil Co. has staked location for a Smackover lime test in Bowie County, 2 miles southwest of Elan. It will be 2 Louis Heilbron, on 97-acre lease in M. H. Janes Survey, 800 ft. west of No. 1 dry hole at total depth 7,836 ft. This failure had a show of heavy black oil and some gas through 24 perforations at 7,708-16 ft.

Cass County.—Skelly Oil Co. 1 Addie S. Baldwin, J. Taylor Survey, northwest of Rodessa pool and 6 miles east of Kildare, was completed for 1,400,000 cu. ft. gas through 24 perforations at 5,852-61 ft., total depth 6,731 ft. The company has moved ½ mile north to drill 1 Bemis.

Panola County.—Continental Oil Co. 1 Burnett Bros. was completed dually from Hill and upper Pettit zones for 29,000,000 cu. ft gas daily. The Hill zone was perforated 4,955-85 ft., making 12,500,000 cu ft. gas, while the upper Pettit made 16,500,000 cu. ft. This well is located on the Carthage gas-distillate structure.

Wood County.—Failure for the northeast edge of the Quitman pool was registered at Shell Oil Co., Inc. 1 White-White Unit, H. Anderson Survey, which was abandoned at 6,380 ft. Shell 1 Whatley, deep discovery on southeast flank of Manziel pool, continues to swab after retreating with acid in an effort to stimulate production. Last gage while swabbing showed 37.8 bbl. of oil in 21 hours. The zone treated was from 8,455-8,525 ft.

Smith County.—Another disappointment was registered for the Sand Flat area when Humble Oil & Refining Co. 1 Shamburger was dry at 7,590 ft. This failure is 6,000 ft. southeast of Skelly 1 Chizum discovery. Sun Oil Co. 1 Patterson, west extension, was rigging up pump. Skelly Oil Co. has made location for 3 Chisum, 1,739 ft. north, 1,145 ft. west of northeast corner J. W. Stewart Survey in Daniel Minor Survey, south offset to the discovery.

Several important wildcats were dry. In Camp County, Mid-Continent Petroleum Co. 1 McGahee was dry at 8,352 ft., and Tide Water and Seaboard 1 Roberts was also dry. In Henderson County, Delta Drilling Co. 1 Texas Pecan Nursery was dry at total depth 10,689 ft.

In Van Zandt County, Northern Ordnance, Inc. has announced location for 1 Curtis Shelton in Leander Smith Survey, 1 mile southeast of Martin's Mill. Humble Oil & Refining 1 Joe Surratt, 1 mile southeast of Edgewood, in J. Wrade Survey, was drilling at 5,673 ft.

EAST TEXAS WILDCAT COMPLETIONS

Cass County: Skelly Oil 1 Addie S. Baldwin, 1,980 ft. from S and E, J. Taylor Sur., northwest of Rodessa pool, 6 mi. E. Kildare, elev. 203 ft., perf. 5,853-61 ft., IP 1,400,000 cu. ft. gas, TD 6,731 ft.

Henderson County: Delta Drlg. 1 Texas Pecan Nurseries, 4,447 ft. from n'ly N, 660 ft. from e'ly E, J. M. Arnest Sur., dry, TD 10,689 ft., elev. 400 ft., Paluxy 7,160 ft., Glen Rose 7,530 ft., Massive anhydrite 9,240 ft., Pettit 10,310 ft., Travis Peak 10,505 ft.

Smith County: Humble Oil & Refining 1 Shamburger, 1,680 ft. from S, 990 ft. from W, 95.25-ac. tract, Hawkins Sur., 6,500 ft. SE Skelly 1 Chizum. Sand Flat pool discovery, dry, TD 7,590 ft., elev. 532 ft., Pecan Gap 3,320 ft., Austin 4,597 ft., Woodbine 5,085 ft.

LOUISIANA GULF

Condensate Field Opener Still Making Tests

NEW ORLEANS. — Continental Oil Co. 1 Prairie Land & Canal Co., previously reported as opening a new condensate producing area southwest of Lake Charles in Calcasieu Parish, has been gaged, making 175 bbl. of 53-gravity condensate daily through an 8/64-in. choke with tubing pressure 5,600 lb., although at the time of latest report it was still making a series of tests. Casing was perforated at 10,410-10,420 ft. for the present completion and it is not likely that it will reperforate. Total depth is 11,319 ft.

Gulf Oil Corp.'s new producer on the Section 28 Dome, 1 Iowa-St. Martin Land Co., has been recompleted after squeezing off the bottom perforations at 11,050-74 ft. and 11,082-11,088 ft. and flowed 389 bbl. of 30-gravity oil daily through a 5/32-in. choke on potential test. Original completion through lower perforations had been at the rate of 211 bbl. daily.

Pure Oil Co. has completed its southwest flank test at Gueydan field, 16 Alliance Trust, making 301 bbl. of 33.5-gravity oil daily through a 10/64-in. choke with tubing pressure 1,475 lb. and casing sealed. Earlier tests, through perforations at 9,698-9,716 ft. had shown gas and condensate. The new completion is at 9,914-42 ft.

Humble Oil & Refining Co. 1-B Cameron Parish School Board, deep wildcat on the Catfish Lake prospect, Cameron Parish, is standing cemented at total depth of 10,127 ft. in sandy shale after having run a string of casing for production test. Humble is also setting casing in its 4 Louisiana Furs, deep test in the Pecan Island area, after having drilled to a depth of 11,670 ft.

California Co. has announced location for a new wildcat in Jefferson Parish, 1 E. P. Brady et al, in Section 2-16s-23e. It is scheduled to drill to a depth of 11,000 ft.

At Napoleonville dome, Assumption Parish, Tide Water Associated Oil Co. et al are preparing to make a production test in 1 Kessler & Sternfels, Unit 2, at the 9,000-ft. level. After setting casing to total depth of 9,034 ft., it tested gas on a drill-stem test with pipe perforated at 8,998-9,000 ft. Additional shots were placed at 9,000-10 ft. and screen is being run for completion. It was reported running high on the regular field pay.

LOUISIANA GULF COAST WILDCAT COMPLETIONS

Assumption Parish: Phillips Pet. 1 Amelia, W. Amelia area, 13-16s-13e, dry, TD 12,020 ft.

TEXAS GULF COAST

Extension Well Opens New Harris County Sand

HOUSTON.—Completion of an extension well which opens a new sand in the Joyce Richardson field, Harris County, opening of a new gas-producing area in Wharton County, and reported showings of oil in Grimes County were highlights of Gulf Coast activity during the past week.

General Crude Oil Co. 1 Rorick, at Joyce Richardson, was completed in a new deeper sand through perforations at 7,141-45 ft., flowing 194 bbl. of 38.1-gravity oil daily through a 5/32-in. choke with tubing pressure of 900 lb., and gas-oil ratio only 660.:1. Top of sand was reported at 7,120 ft. This well is about 3,400 ft. southwest of the nearest producing well and L. M. Josey has already started moving rig to a north offset. The field produces generally from a gas-distillate sand around 6,900 ft., and there were only two oil wells in the area, both from the upper sand.

Superior Oil Co. has failed to find commercial showings in its wildcat in the Hungerford area, 1 Hudgins, after drilling to a depth of 8,501 ft., and plugged back to complete as a shallow gasser.

Northern Ordnance Co. 1 Quinn, in the Stoneham area, southern Grimes County, drilled to total depth of 7,518 ft., failed to find showings in the Wilcox and set casing to 3,636 ft. for a test of Cockfield sand, top of which was reported at 3,615 ft. Casing was perforated at 3,623-28 ft. and the well was swabbed, showing some oil, but still had not flowed at the time of latest report.

Sun Oil Co. has completed its 1 Thompson, over a mile east of production in the Seabreeze area, Chambers County, but no gage is available at this time. The well had cleaned itself through a ¼-in. choke from perforations at 9,450-75 ft., showing flowing pressure of 2,550 lb. on tubing, but was immediately shut in without a gage. Total depth is 9,929 ft. with 5½-in. casing set at 9,525 ft.

In Hardin County, American Republics Corp. and Houston Oil Co. 1 H&TC fee, in the North Beach Creek area, was perforating casing at 6,234-43 ft. and 6,247-52 ft. for the first production test. Earlier this well had made a drill-stem test in this sand section, recovering 19 stands of 34.7-gravity oil and a little mud.

TEXAS GULF COAST WILDCAT COMPLETIONS

Brazoria County: Gulf Oil Corp. 1 S. M. Allen et al, Allen dome, dry, 8,178 ft.

Jefferson County: Glen H. McCarthy 2 McFaddin Trust, 7. Stowell area, T&NO Sur., A-143, dry, TD 9,824 ft.

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PERMIAN BASIN

Andrews County Wildcat Swabs 198 Bbl.

MIDLAND.—Stanolind Oil & Gas Co. 1-F Midland Farms, discovery from Permian lime in southeastern Andrews County, west of Mabee pool and northeast of North Cowden pool, on swabbing test made 198 bbl. 27-gravity oil from lime pay at 4,820-88 ft. No water appeared with the oil, and operator may deepen before treating with acid. There is no gas with the oil. Casing seat is at 4,756 ft., well above top of the pay. Anderson-Prichard Oil Corp. 1 McCrea, Section 1, Block A-48, Public School Land, west of the Fullerton pool, which has already assured an extension from the upper Clear Fork pay, acidized the lower zone and made 59.3 bbl. in 9 hours. The extension is bottomed at total depth of 7,004 ft. Another short extension to the southwest for the pool is Frankel Bros. 4-A University, Section 17, Block 13, University Survey, which acidized the upper pay with 8,000 gal. from 6,804-6,965 ft., and flowed 750 bbl. in 11 hours. The lower pay has not yet been treated with acid. Total depth is 7,036 ft. The Fuhrman pool was extended ¼ mile northwest at Shell Oil Co., Inc., and Cities Service Oil Co. 4 E. F. King, total depth 4,474 ft., which flowed at the rate of 1,000 bbl. per day from lime pay 4,280-4,454 ft., plugged-back depth. This is one of the best wells for the north part of the pool, and indicates possible linking with the Deep Rock area to the northwest.

Crane County.—The Texas Co. 1 Hobbs, southeastern Crane County Devonian discovery, was flowing after acid treatment of the zone with 500 gal. acid through perforations 5,300-50 ft. After swabbing for 3 hours, the well flowed 112 bbl. for 11 hours, and went dead, but kicked off again after one run of the swab, and made 19 bbl. in 1 hour.

Gaines County.—Stanolind Oil & Gas 1 T. S. Riley, NW NW Section 79, Block H, D&W Survey, 7 miles west of Cedar Lake pool, gaged 10,000,000 cu. ft. gas from Yates sand at 3,230-3,466 ft. on drill-stem test through ⅝-in. choke. This wildcat is 9 miles east by north of Honolulu Oil Corp. 1 Homan, which was completed as a gasser from the Yates zone. It is drilling ahead.

Pecos County.—Standard Oil Co. of Texas, Section 27, Block 8, H&GN Ry. Survey,

(Continued on page 117)

MICHIGAN

Arenac County Well Restricted to 600 Bbl.

SAGINAW.—Hailed as Michigan's best strike in 2 years, flow from Basin Oil Co.-Don Rayburn 1 Martin-Chamberlain in Section 8 of Deep River Township, Arenac County, was being restricted to around 600 bbl. per day pending a session of the state oil advisory board May 24 which will consider the future of the new Deep River pool.

Meanwhile another heavy producer in Arenac County helped focus interest of oil men on the Northern Michigan section as Smith Petroleum Co. completed 1 Alfred A. Kerr in Section 14 of Adams Township for a daily potential of 5,000 bbl. The Deep River gusher's potential was 10,000 bbl. Both are producing from the Dundee formation.

Serving to define limits of Arenac County production, however, Rayburn completed 1 Consumers Power Co. in Section 25 of Moffatt Township, Arenac County, as a dry hole at 3,084 ft. It was a wildcat test of the Dundee.

The past week resulted in 15 oil-test completions and a gas well in 12 Michigan counties. Seven of 10 dry holes were wildcat tests, among them one of the few tests drilled in Michigan's Upper Peninsula. The latter, in Chippewa County, was dry at 1,050 ft.

Aside from the two big Arenac wells, operators developed a 290-bbl. producer.

The 1944 drilling permit list increased to 195, the state conservation department approving 13 additional ones for 9 counties, 3 locations in Clare County, 3 in Allegan, 1 each in Arenac, Barry, Gratiot, Ionia, Kalkaska, Missaukee and Newaygo.

MICHIGAN WILDCAT COMPLETIONS

Arenac County, Moffatt Township: Don Rayburn 1 Consumers Power Co., C N½ SE NW 25, dry in Dundee formation, TD 3,084 ft.

Chippewa County, Drummond Township: E. R. Morris 1 Kreelan Lumber Co., SE NW SE 17-41n-7e, dry, TD 1,050 ft.

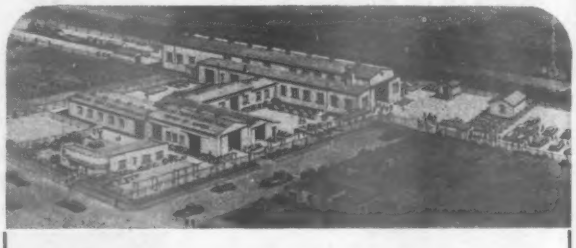
Hillsdale County, Fayette Township: Goodheart & Sindecuse 1 Roy Salway, SW SW SW 5-6s-3w, dry, TD 2,380 ft.

Mecosta County, Wheatland Township: C. L. Maguire, Inc., 1 M. H. Oliver, S½ SE NE 11-14n-7w, dry, TD 1,546 ft.

Newaygo County, Easley Township: Pure Oil Co. 1 J. D. Peterson, C E½ SE NW 16-11n-11w, dry in Monroe formation, TD 3,230 ft.

Osceola County, Cedar Township: Sun Oil Co. 4 William H. Richardson, C S½ NE NW 23-18n-9w, dry in Dundee, TD 4,016 ft.

Ottawa County, Robinson Township: Clifford A. Perry 1 Edwin Boerema, NE SE NE 35, dry in Traverse limestone, TD 1,721 ft.



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DALLAS, TEXAS

OKLAHOMA

Carter County Gets New Pennsylvanian Pool Southeast of Hewitt

CARTER County was in the limelight this week with a new pool, opened by Texas Co. 1 Chubbee, NW NW SW 5-5s-1w, which flowed 355 bbl. of 36.9-gravity oil in 4 hours through a 1-in. choke from the Bayou pay in the Pennsylvanian at 2,760-80 ft. The new pool lies southeast of the east extension to the old Hewitt field, and although probably limited in extent, since several dry holes have been drilled in the general area, it is getting a fast play because of the shallow depth.

In the West Edmond field, preparations were being made to take bottom-hole pressures on key wells by the engineers of the Oklahoma Corporation Commission. Fox & Fox 1 Hassell, SE SE 5-13n-4w, extended the field ½ mile southeast, when it flowed 524 bbl. of oil in 3 hours through a tubing choke, from the Bois d'Arc of the Hunton at 6,860-6,930 ft. Bourland et al 1 McDowell, SE SW 28-14n-4w, was dry and ordered abandoned at 6,903 ft., after missing the Bois d'Arc, although offset by producers on the west and south. Denver Producing & Refining Co. cemented casing at 7,210 ft. in its 1 Bailey, SW SE 19-13n-4w, and will probably acidize the hard, tight Hunton it found in a core. This well is 9¼ miles south of the most northerly drilling well, which is located in the NW SE 4-14n-4w, and the most northerly drilling well is 2½ miles east and 1¼ miles north of the nearest producer. This gives some idea of how confidently the operators are stepping out to back their judgment that West Edmond will be a true major field.

OKLAHOMA WILDCAT COMPLETIONS

Cleveland County: Kerlyn et al 1 Loveless, NW NE 14-7n-1w, dry, TD 7,244 ft., Wilcox 7,213 ft.

Creek County: L. B. Jackson 1 Berryhill, SE SW NE 11-18n-10e, dry, TD 2,366 ft.

McCurtain County: Appel et al 1 Pendergast, NW NW NE 21-7s-21e, dry, TD 1,500 ft.

C. F. Carter et al 1 Merritt, NE NW NE 33-6s-21e, dry, TD 460 ft.

Noble County: Fox & Fox 1 Corby, SW SE SE 22-24n-2w, dry, TD 5,100 ft., Arbuckle 5,010 ft.

Pottawatomie County: Texas Co. 1 McLaughlin, NW NE SW 32-9n-2e, dry, TD 6,028 ft., second Wilcox 5,973 ft.

Seminole County: Newt Barrett et al 1 Baker, NE NW SE 29-10n-6e, dry, TD 4,550 ft., Wilcox 4,539 ft.

OHIO, KENTUCKY

Middle Wellington Extended Location to East

COLUMBUS.—The Middle Wellington pool was extended a location to the east by a 3,000,000-cu. ft. well, Ohio Fuel I Heidenreich, Lot 3, Wellington Township, Lorain County. Clinton at 2,379-2,381 ft. gaged 265,000 cu. ft. and at 2,389-2,396 ft. 2,735,000 cu. ft. with a rock pressure of 1,175 lb.

The easterly limits of the Clayton pool are now more closely defined by the completion of a gas well, the Price Oil 1 Curry in Section 9, Clayton Township. Sand at 3,297-3,347 ft. gaged 504,000 cu. ft. with 985 lb. rock pressure.

Industrial Gas extended its gas pool in the northern part of Bloom Township, Morgan County, 1 mile to the southwest. Sand was found at 4,382-4,407 ft. and gaged 724,000 cu. ft. with a rock pressure of 1,150 lb.

F. L. Lyons completed another good well on the west side of the Battlesburg pool in Section 9, Pike Township, Stark County. The well, on the Malavites tract, shut in after shot at 1,200,000 cu. ft.

South Penn Oil is drilling below the Oriskany sand in its deep test at Woodsfield. The sand was very hard, and had no shows of either oil or gas.

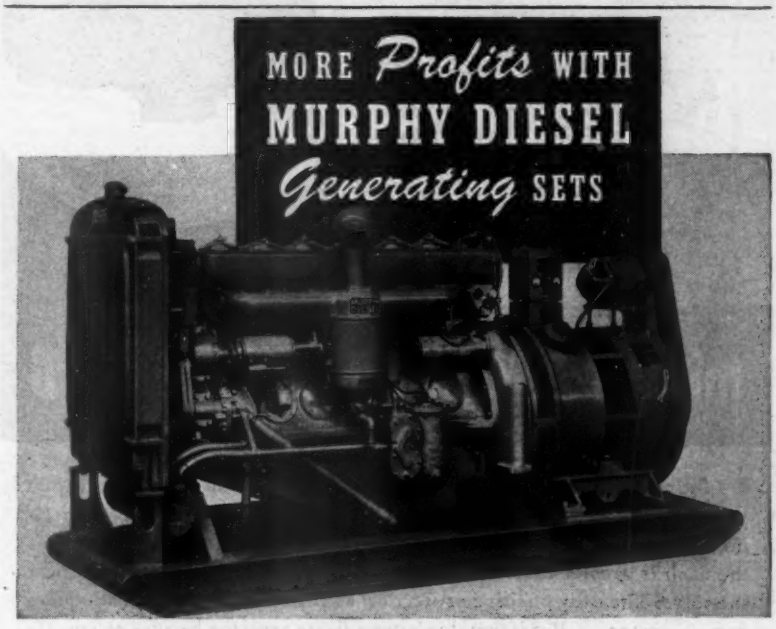
WESTERN KENTUCKY

OWENSBORO, Ky.—Seven oil wells, including a 265-bbl. well in the Uniontown field in Union County, were completed in Western Kentucky during the week. The outstanding well above noted was J. W. Menhall 1 St. Agnes church, C W½ SW SW 20-P-19, which is producing from the Waltersburg sand at 1,741-71 ft., total depth 2,263 ft.

The recently opened pool near Albany in Clinton County, near the Tennessee border, started a drilling campaign which is reported now to have reached 21 drilling wells in Clinton, 7 in Cumberland and 7 in Wayne counties. Of the oil pays thus far developed in part one lies at 200 ft., called the Stray sand, and the other between 500 and 600 ft., Trenton or Sunny Brook. Due to the lack of shipping facilities production is kept down and what is being marketed is carried away in tank trucks to Glasgow and Somerset. The oil brings $1.20 per bbl. at the well. Several of the major companies and a considerable number of important independents have been giving the field their consideration.

WESTERN KENTUCKY WILDCAT COMPLETIONS

Henderson County: National Associated 1 Henry P. Barrett, NE NW NW 2-O-23, 7 mi. SW of Henderson, dry at 2,675 ft., lower Glen Dean 1,912 ft., Barlow 2,195 ft.



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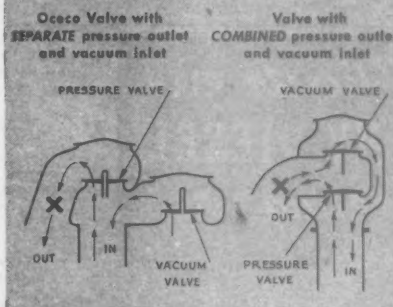

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Logan County: Shell 1 J. M. Stagner, SE SE SW 14-F-32, dry at 1,675 ft., Devonian lime top 1,425 ft.

EASTERN KENTUCKY

ASHLAND.—Drilling activities continued unabated in Eastern Kentucky this week but reports from the various fields did not reveal any completions for the first time in a number of weeks.

Several locations were made, and the weather has been a favorable factor in the speeding-up of road-building and moving activities, especially in the gas field areas.

Two or three wells have reached total depth levels and completion data are expected next week.

INDIANA WILDCAT COMPLETIONS

Posey County: Ira Hodges-W. E. Walter 1 Elbert-Pollard, NE NE NW 36-8s-14w, dry at 2,317 ft.

ILLINOIS

Madison County Devonian Lime Well Best of the Week

CENTRALIA, Ill.—Thirty-one wells were completed in Illinois in the past week in review, but only 11 were productive of oil. The total initial production of 1,739 bbl. represented an average per well of 158 bbl. Nine wildcat completions were all dry. Five new wildcats were included in the 26 new operations reported.

Two miles northwest of West Salem, Edwards County, Texas Co. 1 C. Lambright, a Parkersburg pool outpost, SW SE SE 1-1n-10e, in a 1-hour drill-stem test in McClosky lime at 3,216-18 ft., developed 1,870 ft. of clean oil, 130 ft. of drill-cut mud and 120 ft. of sulfur water and pipe was being set.

The largest well of the week was Obering et al 2 Becker-Pence, SE NE SE 9-4n-6w, Marine pool, Madison County. It had Devonian lime at 1,688 ft., total depth 1,705 ft. Water appeared at 1,696 ft. to the bottom, and the hole was plugged back to 1,696 ft. and the well pumped an initial of 410 bbl. of oil and 40 bbl. of water. Bell Bros. completed at 343-bbl. well in 1 Indiana Bank-C, E½ SW SE 13-1s-3e, Divide pool, Jefferson County, in McClosky lime at 2,751-57 ft. and 2,783-89 ft., acidized. Superior Oil Co. 1 T. J. Wick, SE NE SE 25-2s-10e, Albion pool, Edwards County, started at 218 bbl. from acidized McClosky lime at 3,147-50 ft.

ILLINOIS WILDCAT COMPLETIONS

Clinton County: A. Schierman 1 Zimmerman, NW NE SE 34-3n-4w, dry at 1,066 ft. Cypress sand 847 ft., Paint Creek 929 ft., Benoist 995 ft.

Hamilton County: Kingwood et al 1 J. Swader, NE NW SE 2-5s-7e, dry at 3,605 ft. Upper Kinkaid 2,202 ft., Cypress 3,053 ft., Benoist 3,254 ft., Aux Vases 3,387 ft., Fredonia 3,483 ft., McClosky 3,492 ft.

Jasper County: Kingwood 1 J. Flinn, NW NW NW 8-6n-8e, dry at 3,114 ft. Menard 2,234 ft., Cypress 2,692 ft., Benoist 2,791 ft., Aux Vases 2,880 ft., Fredonia 2,967 ft., McClosky 2,967 ft.

Jefferson County: Magnolia 1 Bullock unit, NW NW SE 34-2s-2e, dry at 2,838 ft. Tar Springs 2,028 ft., Cypress 2,382 ft., Benoist sand 2,526 ft., Aux Vases 2,608 ft., Fredonia 2,703 ft., McClosky 2,757 ft.

Bell Bros. & Ashland 1 Avery Minor, C SW NE 25-1s-3e, dry at 2,950 ft., Menard 2,020 ft., Cypress 2,470 ft., Benoist 2,615 ft., Aux Vases 2,695 ft., Fredonia 2,820 ft., McClosky 2,851 ft.

Montgomery County: George Cassens 1 Marburger, NW SE SE 31-8n-5w, dry at 695 ft.

George Cassens 1 H. Marburger, NW SW NW 6-7n-5w, dry at 655 ft.

Richland County: Kingwood 1 S. E. Cut-

shall, NW NW SE 14-3n-10e, dry at 3,254 ft. Palestine 2,238 ft., Cypress 2,773 ft., Benoist 3,008 ft., Fredonia 3,148 ft., McClosky 3,186 ft., St. Louis 3,245 ft.

Wabash County: Skelly Oil 1 H. L. Bass, NE SE NE 17-2s-14w, dry at 3,161 ft. Menard 2,223 ft., Cypress 2,711 ft., Benoist 2,850 ft., Aux Vases 2,987 ft., McClosky 3,040 ft.

Wayne County: Bell Bros. 1 C. R. Bowles, SW SW NE 14-1s-8e, dry at 3,255 ft., Menard 364 ft., Cypress 2,800 ft., no Benoist logged, Aux Vases 3,076 ft., Fredonia 3,169 ft., McClosky 3,180 ft.

LA.-ARK.

Ashley County Wildcat to Take Drill Stem Test

MAGNOLIA, Ark.—Arkansas operators were watching Union Producing Co. E-1 Crossett Lumber Co., a wildcat in 12-19s-9w, southwestern Ashley County. After reaching a total depth of 5,210 ft., electric log was made and the well was cored from 5,175-90 ft., and from 5,190-5,210 ft., with recovery of 10 ft. of sand and streaks of lime reported in first core 5,175-90. Union is preparing to make a drill-stem test. Surface elevation is 137 ft. The well is located about 20 miles southeast of the New London field.

Atlantic Refining Co. was getting an 8-bbl. per hour flow from its 1 Tisdale Unit, S½ SE 8-18s-22w in the Dorcheat field. Mid-States Oil Co. 3 S. J. Beene-Waller in 3-20s-20w, Haynesville Extension, flowed 65 bbl. per hour for 4 hours through a ¾-in. choke from casing perforations at 5,476-92 ft.

ARKANSAS WILDCAT COMPLETION

Prairie County: Victory Development 1 Clayton, SE NE 10-1n-5w, dry, TD 3,202 ft.

NORTH LOUISIANA WILDCAT COMPLETION

Caddo Parish: R. F. Kayser 1 Gerdes, SE SW SE 5-14n-16w, dry, TD 2,667 ft.

MISSISSIPPI WILDCAT COMPLETIONS

Jasper County: Gulf 1 Gus Husband, 627 ft. S and 607 ft. W, NE NW SE 25-1n-12s, dry, TD 5,716 ft.

F. R. Sylvestre 1 Eddy, SE SW 33-1n-13e, dry, TD 5,373 ft.

ALABAMA WILDCAT COMPLETION

Washington County: Humble Oil & Refining Co. 2 C. D. Scott, 1,984 ft. S and 661 ft. E, NW 33-6n-4w, dry, TD 7,327 ft.

CANADIAN FIELDS

Important Extension of Taber Field Indicated

CHATHAM, Ont. — Indicating an important extension of the Taber field to the south and east, Imperial-British Dominion-Conrad 1, LSD 13, 6-8-15w4, got the Taber sand at 3,182 ft. and cored 3 ft. of marker saturation and porosity between 3,184-87 ft. Drill-stem test showed a rise of 600 ft. of oil with some gas in the stem in 1 hour.

Most northerly of the Dominion Oils group, Taber-Province 73-20-B, LSD 5, 20-9-16w4, finished at 3,194 ft., is swabbing and looks like a good producer.

North extension. — In the North Turner Valley extension, British Dominion 7, LSD 12, 17-21-3w5, outpost well to the northeast, finished at 8,629 ft. with Madison contact at 8,150 ft. getting both porous horizons of the limestone in a normal thickness.

Aldersyde. — On the Aldersyde structure east of Turner Valley, New Ranchmen's-Snyder 1, LSD 16, 34-19-29w4, is deepening below 7,911 ft. after two drill-stem tests of the top 45 ft. of the limestone showed some oil, a fair gas flow and traces of water.

Twin River.—On the Twin River structure in southern Alberta, Pacific Oil & Refining 2, LSD 13, 2-2-20w4, got the Madison limestone at 3,913 ft. Casing is being run and cable tools rigged to drill into production.

WILDCAT COMPLETIONS AND DISCOVERIES

	Week ended May 13, 1944					Cumulative total 1944				
	Oil	Dist.	Gas	Dry	Tot.	Oil	Dist.	Gas	Dry	Tot.
Ohio	0	0	0	0	0	0	0	7	19	26
Indiana	0	0	0	1	1	2	0	0	8	10
Illinois	0	0	0	9	9	7	0	0	102	109
Kentucky	0	0	0	2	2	4	0	0	19	23
Michigan	0	0	0	7	7	4	0	0	83	87
Kansas	1	0	0	13	14	21	0	3	152	176
Nebraska-Missouri-Iowa	0	0	0	0	0	1	0	0	7	8
Oklahoma	0	0	0	7	7	16	0	8	83	107
Texas:										
North Central	0	0	0	3	3	21	0	0	102	123
West	0	0	0	5	5	11	0	1	59	71
Panhandle	0	0	0	0	0	0	0	0	3	3
East	0	0	1	2	3	3	0	1	46	50
Gulf Coast	0	0	0	2	2	16	4	4	65	89
Southwest	1	0	0	4	5	13	3	9	90	115
Total Texas	1	0	1	16	18	64	7	15	365	451
Louisiana:										
North	0	0	0	1	1	2	0	0	21	23
Gulf Coast	0	0	0	1	1	3	4	0	24	31
Total Louisiana	0	0	0	2	2	5	4	0	45	54
Arkansas	0	0	0	1	1	2	0	0	22	24
Mississippi and Southeast	0	0	0	3	3	4	0	0	30	34
Montana	0	0	0	0	0	1	0	1	4	6
Wyoming	1	0	0	1	2	7	0	0	7	14
Colorado-Utah	0	0	0	0	0	1	0	0	19	20
New Mexico	0	0	0	1	1	1	0	1	23	25
California	0	0	0	3	3	3	0	5	59	67
Total United States	3	0	1	66	70	143	11	40	1,047	1,241
Total previous week	7	0	1	73	81					

KANSAS

Operators Looking Forward To Spacing Rules Relaxation

KANSAS operators are hoping that PAW will act promptly on the recommendation of District 2 Production Advisory Committee that spacing regulations in 50 pools be reduced from 40 acres to 20 acres. The past week's record of 14 oil wells, 1 gas well and 7 dry holes out of 22 field completions, is an indication of the problems the 40-acre spacing rule brings on.

Sinclair Prairie Oil Co. apparently had a failure in their attempt to find oil along the Kansas-Colorado line, as their 1 Glad & Brook, SE NW NE 19-13s-42w, west of Sharon Springs in Wallace County failed to get oil from tests at 3,939-52 ft. The well was drilled to granite at 5,972 ft., total depth, but backed up to test a soft dolomite at the shallower depth where there was some spotted staining.

Atlantic Refining Co. 1 McDaniels, NE SW 34-19-33w, a wildcat 3 miles north of the Shallow Water pool in Scott County, is coring below 4,750 ft. The Lansing was dry at 3,862 ft., and top of Mississippi lime checked at 4,651 ft.

KANSAS WILDCAT COMPLETIONS

Barber County: C. M. Coats et al 1 Hull estate, NE NE 3-33-14w, dry, TD 5,350 ft., Arbuckle 5,326 ft.

Barton County: W. L. Hartman 1 Powell, NW NW 1-20-13w, dry, TD 3,475 ft., Arbuckle 3,427 ft.

Ellsworth County: Bridgeport Oil 5 Lielak (Strat), NE 34-15-9w, dry, TD 3,162 ft., Arbuckle 3,131 ft.

Phillips Petroleum 1 Evolanek, SE SE SW 29-14-9w, dry, TD 3,183 ft., Arbuckle 3,149 ft.

Graham County: Anderson-Prichard & Texon 1 Gudgel, SW SW NE 15-6-22w, dry, TD 3,966 ft., Arbuckle 3,860 ft.

Harvey County: Holl & Branine 1 Lagree, NW SE 9-23-3w, pumped 5 bbl. oil, original TD 3,385 ft., PB to 3,358 ft., Mississippi 3,305 ft.

Lincoln County: Dickey Oil 1 Eckart, SW 24-11-7w, dry, TD 4,144 ft., Arbuckle 4,081 ft.

Marion County: Wolf Creek 1 Unran, SE NE SW 33-19-1e, dry, TD 2,831 ft., Mississippi 2,769 ft.

McPherson County: Phil-Han & Phillips Petroleum 1 Keifer, NW NW SE 11-19-1w, dry, TD 2,890 ft., Mississippi 2,873 ft.

Morris County: A. M. Landon 1 Roediger, SW NW NW 6-15-6e, dry, TD 2,417 ft.

Pratt County: Hinkel & Hatfield 1 Elliott, SW NE SW 31-27-13w, dry, TD 4,570 ft., Arbuckle 4,520 ft.

Shell Oil 1 Wendel, SE NE NE 31-29-11w, dry, TD 4,852 ft., Arbuckle 4,812 ft.

Reno County: Falcon Seaboard & Lion 1 Miller, SW 26-25-10w, dry, TD 4,350 ft., Arbuckle 4,331 ft.

Rice County: Nelson Drilling 1 Zajic, SW 35-18-6w, dry, TD 3,499 ft., Mississippi 3,449 ft.

APPALACHIAN FIELDS

New Big Injun Oil Area For Washington County

PITTSBURGH. — In Morris Township, Washington County, Pennsylvania, Frank Cowell et al completed a test on the H. S. Day farm, 1 mile south of Prosperity, good for better than 10 bbl. a day from the Big Injun sand. The sand was topped at 2,065 ft.; oil 2,075-81 ft.; total depth 2,085 ft. No Big Injun oil has been previously recorded in the area. On a line from Prosperity to Point Lookout, there have been several oil pools developed, but mostly Fifth sand. The new production lies along that line.

In Jackson Township, Greene County, Pennsylvania, Equitable Gas Co. completed a test on the J. C. Huffman farm (George Huffman) showing for 1,500,000 cu. ft. gas. The Bayard sand was topped at 3,303 ft. with some gas at 3,304 ft.; second Bayard

(Continued on page 117)

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Among the

Drilling Contractors

Ajax Drilling Co. has been awarded contract on the Michigan Consolidated Gas Co. and Sohio Petroleum Co. 1 Maud Sheffield et al, in NW SE NE 1-16n-8w, Mecosta County, Michigan.

Alberta Drilling Co., Calgary, Alta., is handling completion of a test of the Madison limestone for Pacific Oil & Refinery, of Lethbridge, in the Twin River area of southern Alberta, and is also drilling 1 Trans-Alberta in the same area in LSD 8, 21-1-20w4. The company has the contract for two other wells for Trans-Alberta Oils, one in the Taber field in LSD 16, 12-9-17w4, to start immediately, and the other completion from 100 ft. of Trans-Alberta 1 Alliance, in LSD 15, 18-20-1w4, on the Antelope Hills structure close to the Saskatchewan boundary.

T.-C.-G. Drilling Co. has opened headquarters in Midland, Tex. The concern is a merger of the former operations of the E. B. Gill Drilling Co., with the activities of Philip Taber, Tulsa, and C. B. Colemen, Oklahoma City. The concern will shortly have five rotaries running in the Permian basin.

Red Wells was moving in rig to start the C. E. Weller 1 Kapral, in NE NE NE 7-10n-2w, Gratiot County, Michigan, a mile southeast of the village of Ithaca.

K de K Drilling Co., Vermilion, Alta., has the contract for a wildcat test, M 1 Iscris, LSD 13, 36-53-6w4, near Rusylvia, Alta., and some 20 miles north of the Vermilion field.

H. L. Blackstock, drilling contractor, who recently returned to Oklahoma from the Illinois basin area, has opened an office in Oklahoma City.

Camay Drilling Co. is making preparations to begin drilling operations on a new well to be drilled for Capital Co. west and north of the Turnbull Canyon field in California, the derrick having been erected several days ago.

H. H. Howell, Corpus Christi, Tex., has contracted to drill H. J. Porter et al 1 Welder, a wildcat operation west of the Fitzsimmons field, Duval County, Texas. Contract calls for drilling to 4,500 ft.

Muskegon Development Co. has been awarded drilling contract on the Regal Dutch Petroleum Co. 1 Dykhuis, in SE SE NW 2-4n-15w, Allegan County, Michigan.

J. W. Lang is the drilling contractor on Michigan Devonian Petroleum Co. and J. W. Lang, Inc. B-1 Dozeman-Schaap, in NE NW NE 11-4n-15w, Allegan County, Michigan.

Ashby Drilling Co. will drill two tests in Michigan, for two different operators. For Gulf Refining Co. it will drill the 5 T. F. Marston, in C S½ NE SE 1-14n-4e, Bay County, and for Michigan Consolidated Gas Co., Production and Pipe Line Dist., it will drill the 1 State of Michigan et al, in NW SE NW 13-15n-8w, Mecosta County.

I. F. Scott is the contractor on the Osceola Transportation Co. 1 Henry Smith and others, in C NW 15-14n-6w, Isabella County, Michigan.

Parker Drilling Co. has the 10,000-ft. contract on the California Co. 1 Reeder, in C NE NW 1-8n-17w, Seminole County, Oklahoma, southeast of Cordell. Conductor pipe was set at 152 ft.

Strom Oil Co. is the contractor on Welsh Oil Co. 1 Emil Zelinka, in SW NW NE 10-11n-16w, Muskegon County, Michigan.

E. W. Lederer will drill the Carl E. Grimes 1 J. Lynch, in NE SE NE 25-1s-16w, Van Buren County, Michigan.

Pacific American Oil Co. is acting as drilling contractor for J. L. O'Donnell in the Torrance, California, field and has a new well, 1 West, nearing completion.

Fred Morgan, drilling contractor of Ponca City, Okla., is drilling a test on his own account at the 1 Sodosky, in SE SW NW 12-26n-1w, Kay County, Oklahoma, and was drilling below 3,800 ft. Morgan was contractor on the discovery well which was drilled by R. H. Lynn and associates, and operations taken over by Blackwell Oil & Gas Co.

MARKET QUOTATIONS

Prices as of May 16, 1944

(This service is abbreviated because most refinery products are selling at the Government's price ceilings. Quotations on other products than those shown here furnished on request. Quotations are f.o.b. plant in tank cars and in cents per gallon.)

REFINERY GASOLINE

Octane (A.S.T.M.):	80†	72-74
Mid-Continent*	6.00-6.25	5.750-6.000
Gulf Coast	6.00-6.50	‡5.750-6.250
Northeast Coast	9.80	9.200
California		8.255-6.500

*Basis Oklahoma Group 3. †1939 C.F.R. (research method.) ‡Unleaded.

NATURAL GASOLINE

Grades:	26-70	18-55
Oklahoma (Group 3)	4.750	5.700
North Texas	4.375	5.250
North Louisiana	4.375	5.250
California	4.875	5.500

CRUDE-OIL PRICES

Representative posted schedules per barrel.

East Texas	$1.25
Conroe	1.43
Tepetate, Louisiana	1.18
Illinois basin	1.37
Pecos County, Texas	.95
Bradford, Pennsylvania	3.00
Van, Van Zandt County, Texas*	1.88

*No change since 5-21-41.

A.P.I. REFINERY REPORT

Week Ended May 6, 1944

(Figures in thousands of barrels)

	Dly. crude runs to stills	Stocks—Gasoline	Stocks—Residual	Stocks—Gas oil
Appalachian	152	3,355	363	1,199
Ind., Ill., Ky.	702	19,753	2,633	4,933
Okla., Kan., Mo.	350	8,443	1,226	1,449
Censored area*	2,209	38,785	14,633	15,048
Rockies	101	2,247	559	329
California	802	15,684	30,427	7,480
Total 5-16-44	4,316	88,267	49,841	30,438
Total 4-29-44	4,300	88,462	49,985	30,236
Total 5- 8-43	3,744	87,970	67,659	30,854

*Reports combined on East Coast, Texas Gulf Coast, Louisiana-Arkansas and Inland Texas at request of PAW.

CRUDE OIL STOCKS

(Bureau of Mines Estimate)

Week ended:	Bbl. of crude*
May 6, 1944	234,166,000
April 29, 1944	235,342,000
May 8, 1943	241,856,000

*Excludes unrefinable stocks in California.

Permian Basin, Panhandle

(Continued from page 110)

western part of the county, ran drill-stem test in Delaware sand 5,750-60 ft., and recovered 120 ft. oil-cut drilling mud. The wildcat is shut down at total depth 5,954 ft. in lime. Flowing gage of 23 bbl. per day was registered at Debs Patillo 1 Iowa Realty Trust, Section 61, Block 10, H&GN Ry. Survey, 3 miles south of Lehn pool. This wildcat had pay found 1,300-56 ft. and acidized with 1,000 gal.

Irion County.—Shell Oil Co., Inc., 1 Tankersly, southeast part of the county in Section 12, GC&SF Ry. Survey, was reported to have topped the Ellenburger at 7,360 ft., elevation 2,333 ft., and is bottomed at total depth 7,440 ft.

WEST TEXAS WILDCAT COMPLETIONS

Brewster County: W. B. Hinton 1 Texas American Syndicate, 990 ft. from N and E, Sec. 66, Blk. 10, GH&SA Ry. Sur., dry, TD 9,046 ft., elev. 4,233 ft., Simpson 6,733 ft., Ellenburged 8,365 ft.

Crockett County: John I. Moore 1 A. C. Hoover, 660 ft. from S and E, Sec. 3, Blk. FF, dry, TD 2,510 ft., elev. 2,541 ft., Yates grains 1,145 ft., lime 1,982 ft.

Coke County: Warren Pet. 1 M. W. Fowler, NW NW Sec. 275, Blk. LA, H&TC Ry. Sur., deep test in Blackwell area, dry, TD 6,425 ft., Ellenburger 6,392 ft., show of oil.

Ector County: Stanolind Oil & Gas 1-B W. F. Cowden, SE SW Sec. 12, Blk. 44-In, T&P Ry. Sur., 5 mi. SE Embar-Ellenburger pool, OWDD from 7,000 ft., elev. 3,110 ft., dry, TD 10,829 ft.

Reagan County: Standard Oil Co. of Texas 1-28-358, NW NE Sec. 12, Blk. 12, University Sur., dry, TD 4,750 ft.

SOUTHEAST NEW MEXICO

HOBBS, N. M.—The Texas Co. 1 Baskin, 22-19s-33e, 7 miles south of Corbin pool in western Lea County, had a show of oil in sand at 3,450 ft. and more shows 3,472-75 ft., and was drilling ahead below 3,550 ft. with no further showings reported. Test from 4,210-30 ft. in DeKalb Agricultural Association 1 Magnolia-Stovall, 8-20s-38e, deep wildcat which had show in the lime zone, failed to show any encouragement, and the operator was drilling ahead for the original objective. El Paso National Gas Co. 1 Ginsberg, southeast Lea County Ellenburger project, was reported to have topped the Montoya at 10,710 ft. and was drilling ahead, looking for the top of Simpson.

SOUTHEAST NEW MEXICO WILDCAT COMPLETIONS

Chaves County: Humble Oil & Ref. 1-N State, SE SW Sec. 35-14s-17e, dry, TD 4,014 ft. in igneous rock, elev. 3,615 ft., Abo 1,900 ft.

Appalachian Fields

(Continued from page 115)

3,320 ft. with gas at 3,321 ft. and total depth 3,354 ft.

In German Township, Fayette County, Pennsylvania, Carnegie Natural Gas Co. completed 962 H. C. Frick Coal Co. with a final gage of 794,000 cu. ft. of gas from 1,342-52 ft.

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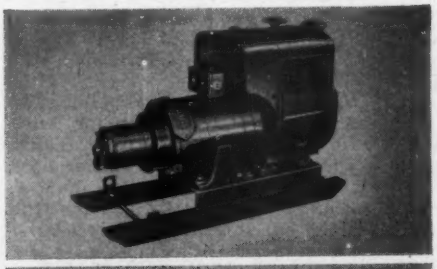

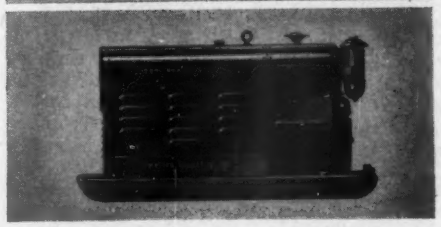

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PERSONALS

Imperial's President Was Lawyer and Legislator

R. V. LE SUEUR, K. C., of Sarnia, Ont., newly elected president of Imperial Oil, Ltd., Canadian subsidiary of Standard Oil Co. of New Jersey, was a lawyer and legislator before he entered the oil business, in which he now is a conspicuous figure. A native of Sarnia, he graduated from Toronto University and Osgoode Hall Law School, and he became a law partner of the late W. J. Hanna, at one time president of Imperial. From 1921 to 1925 he represented West Lambton in the federal House of Commons.

In 1926 Le Sueur was made a director of International Petroleum Co., Ltd., affiliate of Imperial, and he was largely responsible for the development of International's producing, refining, and marketing activities in South America. In 1933 he was chosen a vice president of International and in the same year was elected a director and vice president of Imperial. His advancement to the presidency of Imperial follows relinquishment of that office by G. Harrison Smith to become chairman of the board.

A. P. McPherson, office manager for Turner Petroleum Corp., Mount Pleasant, Mich., has been commissioned a lieutenant (j.g.), and is to report for duty May 29.

D. W. Caswell, who resigned as chief chemist and light-oils superintendent for Bay Petroleum Corp., Denver, to aid in construction of Frontier Refining Co.'s new aviation-gasoline plant in Cheyenne, Wyo., has been made process foreman of the Frontier plant. Caswell, a Texas A. & M. College man, was employed in construction of McMurrey Refining Co.'s plant, Tyler, Tex., and Texas Oil Products Co.'s plant, Gladewater, Tex.

J. H. McLeod was reelected president of Royalite Oil Co., Ltd., at the annual meeting in Calgary, Alta. **G. Harrison Smith** was chosen chairman of the board. **Alexander Hannah** and **S. F. Heard** were elected vice presidents. McLeod was chosen president of Lowery Petroleums, Heard of Southwest Petroleum, and Hannah of Dalhousie Oil Co., all subsidiaries of Imperial Oil, Ltd., operating in Turner Valley.

M. D. Self, Midland, landman for Magnolia Petroleum Co. in the West Texas district for the past 10 years, has resigned to operate as an independent. He is succeeded by **Steve P. Hannifin,** for 12 years the company's landman at Roswell, N. M. Hannifin will continue to look after Roswell work till a successor is named.

E. L. Davis has been appointed acting director of production for Petroleum Administration for War, District 5, succeeding **Lawrence Vander Leck,** who has resigned to enter the consulting field with offices in the Ohio Oil Co. building in Los Angeles.

Stanley J. Meisenburg has been named assistant superintendent of gas plants at the Wood River refinery of Shell Oil Co., Inc., succeeding **Frank C. Cutting,** promoted to refinery superintendent. Meisenburg joined Shell in 1935 as a research chemist. Since early 1943 he had been in charge of the design section in the head office manufacturing department.

George L. Stewart, general manager of the refineries of Imperial Oil, Ltd., Sarnia, Ont., has been made vice chairman of the board in charge of manufacturing, succeeding **L. C. McCloskey,** who retired after 41 years' service.

Ray L. Freeborn, formerly field maintenance engineer for Carl B. King Drilling Co., has joined Continental Oil Co., with assignment to the Wichita Falls district in Texas. **Dick Kramer,** formerly in the oilfield supply business, has taken Freeborn's place in the King organization.

Kenneth R. Teis has resigned as chief petroleum engineer for Sunray Oil Co. to engage in consulting in Tulsa, where he has resided 22 years. From 1925 to 1928 he was chief engineer for Independent Oil & Gas Co., of which Sen. E. H. Moore was president. After that company merged with Phillips Petroleum Co., Teis served for 2 years as city engineer of Tulsa, following which he was connected with Gypsy Oil Co. and Phillips as an engineer. With discovery of the Fitts pool, Teis again was associated with Moore. After the pool had been developed Teis engaged in private practice until 1941, when he joined Sunray.

Ralph Thorne, vice president of the National Association of Foremen, recently presented **Dave Hearn** of Union Oil Co. a charter for the Field Operations Foremen's Club of Union Oil Co. This is the first chapter granted in California and inducted with Hearn were **R. F. Hunter,** vice president, and **K. D. Wells,** secretary-treasurer.

Peter E. Keegan, manager of the industrial-relations department at the Houston refinery of Shell Oil Co., Inc., has been named assistant manager of the personnel department at the head office in New York. He is succeeded at Houston by **Mahlon S. Hale,** who was a member of the industrial-relations staff in New York.

W. E. Johns, who supervised operations of the Lone Star Gas Co.'s compressor stations at Fox field, in Oklahoma, and at Gainesville, Tex., has moved from the Fox camp to Gainesville. The Fox plant will be under the direction of **I. A. Garrett,** and Johns will devote his entire time to the Gainesville plant.

Phillip Maverick, petroleum geologist for the Fort Worth regional office of Securities and Exchange Commission for the past 6 years, has been transferred to Tulsa, where he will serve the commission in a like capacity.

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JOE T. O'KEEFE
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HOWARD HIGBY, Mgr
Pres., Texas Hotel Assn.

A.G.A. ABSTRACTS

(Continued from page 76)

we will obtain complete recovery of all storage gas and will experience a yield of approximately 2,000,000 cu. ft. per pound drop in rock pressure.

Experience shows that water condensate averages 5 gal. per 1,000,000 cu. ft. of gas withdrawn. Blowing wells periodically, less often when storage pressure is high and more often as pressures decline, improved deliverability of wells.

Problems of Underground Gas Storage

F. H. FINN, Peoples Natural Gas Co.; J. J. SCHMIDT, East Ohio Gas Co., and J. B. CORRIN, JR., Hope Natural Gas Co.

ALL underground storage projects of Consolidated Natural Gas Co. operating subsidiaries are reviewed. Acting storage pools in the system cover 34,016 acres and their combined storage capacity is 47,862,000,000 cu. ft.

The paper contains all pertinent data on selection, development and operation of underground storage reservoirs. Authors point out that it is not practical to use too large a pool for storage purposes unless large quantities of excess gas are available. The required volume for reservoir cushion, they point out, is too great in comparison with the deliverability factor. As a rule-of-thumb, the authors recommend any storage pool which will deliver 5,000,000 cu. ft. per day per billion stored on the first ½ billion. In general, smaller reservoirs restored to pressures in the range of 500 lb. are more suitable for meeting peak load conditions. Relatively little cushion-gas requirements is one of the chief attractions of the smaller storage pools.

Study of some of the factors indicates the cost of underground gas storage varies from 3 to 12 cents per 1,000 cu. ft. No allowance is made for return on the investment of equipment used nor for overhead and the cost of gas required for permanent cushion. The costs represent only labor, maintenance, supplies, expenses and rents.

Storage of L.P. and Refinery Gases in Ontario

F. D. HOWELL, division superintendent, Dominion Natural Gas Co., Ltd.

EXPERIENCE with the storage of a propane-air mixture for the purpose of supplementing natural-gas supplies during peak consuming seasons and with underground accumulation of refinery gases for the same purpose is outlined.

A unique method of solving the problem of aboveground storage for the propane-air mixture is described. The company was unable to obtain steel plate for conventional storage tanks within the available time but secured a quantity of 24-in. 9/32-in. seamless pipe. Twenty-six tanks 425 ft. long were laid on piers in wood cradles embedded in concrete. The cradle construction provides for expansion and contraction of the pipe over the widely varying ranges of temperature. One end of the storage vessels is equipped with relief valves, 400 ft. removed from the manually operated controls.

The tanks are connected by 4-in. liquid lines and looper 4-in. vapor lines. They are segregated by valves into four batteries of five tanks each and one of six. Propane is delivered to the plant by tank cars either directly to storage or through the storage-area plant.

The other gas-storage project described in the paper deals with an operation using refinery still gas. Raw refinery gas has a heating value varying from 1,200 to 1,800 B.t.u. per cubic foot and is high in hydro-

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Orbit Gear Operated Master Valve

This valve can be furnished thru all fabricators of Xmas Trees or thru any of your local supply stores at a price comparable to that of leading plug valves, YET, this valve requires no lubrication to effect a seal.

See Pages 2194 to 2111 in 1944 Composite Catalog

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gen sulfide. Gas from the refinery is purified for removal of hydrogen sulfide and a portion is reformed to bring it to a state of B.t.u. value comparable to the fuel supplied in the area.

Underground Storage of Natural Gas

CHARLES W. STUDT, manager of production Union Gas System, Inc., Independence, Kan.

TO assist in meeting peak demands, Union Gas System, Inc., of Independence, Kan., is conducting natural gas underground-storage operations in three previously depleted gas pools in southeastern Kansas which differ widely in their general characteristics.

Underground storage was commenced in March 1940 in a depleted shallow sand gas reservoir in the Longton district, Chautauqua County.

At the commencement of storage operations, the rock pressure was 32 lb. Thirteen of the original wells have been reconditioned and 7 new ones drilled, making a total of 20 active wells.

As of December 1, 1943, the storage reservoir pressure was 167 lb. and the volume of gas stored underground was 1,403,000,000 cu. ft. As of May 1, 1944, the observed field pressure was 124 lb. Gas in storage has been reduced by net withdrawals of 89,000,000 cu. ft. Three 165-hp. compressors with 10½-in. cylinders, connected for pumping gas either into or out of the reservoir, have been used in this operation. With 55 lb. compressor intake and 185 lb. discharge pressure, 3,800,000 cu. ft. of gas may be injected into the sand in 24 hours under present reservoir conditions. With 30 lb. field intake and 68 lb. discharge pressure, 3,500,000 cu. ft. of gas may be withdrawn in 24 hours.

A second storage operation was commenced in the old Buffalo pool, Wilson County. The horizon in which gas is stored is approximately 30 ft. thick, and consists of a single bed of medium hard white limestone with fairly uniform porosity.

As of December 1, 1943, the rock pressure was 49 lb. and the total volume of gas stored was 103,000,000 cu. ft. Net withdrawals of 28,000,000 cu. ft. up to May 1, 1944, reduced the rock pressure to 31 lb.

Union Gas System, Inc. is undertaking its third underground gas storage project in Elk and Montgomery counties, Kansas.

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Our Experience With Underground Storage of Gas in Oklahoma

W. R. KUBISTA, engineer, Oklahoma Natural Gas Co.

FACTORS leading up to the selection of the Osage storage area, near Tulsa, for off-peak accumulation of natural gas are presented and their respective values assigned. The paper describes preliminary examination of the logs of old wells drilled in the selected area and how the information obtained in this manner was followed up by more detailed core analysis of the input and withdrawal wells which was subsequently drilled.

The paper describes how a curve plotted on injected gas practically paralleled the original decline curve until a pressure of 150 lb. per sq. in. was reached. Deviation from the decline curve as pressure increased indicated leakage into a lower sand. The company purchased a few small oil wells producing from the deeper zone and plugged them, effectively terminating the leakage.

Maximum injection rate under present operating conditions is about 20,000,000 cu. ft. per day. Between April 24 and November 9, 1943, reservoir pressure was increased from 13 lb. to 223 lb. p.s.i., and 1,200,000,000 cu. ft. of gas was injected. Withdrawals of 170,000,000 cu. ft. during the 1943-44 winter drew down the measured volume in storage to 1,030,000,000 cu. ft. and pressure receded to 183 p.s.i.

Pipe-Line Material and Specifications

R. G. STRONG, Natural Gas Pipeline Co. of America.

THE industry has been negligent in taking sufficient interest in preparation and use of specifications for materials and in the use of the code for pressure piping. These are vitally important for sound engineering and continuity of service.

The A.P.I. 5-L specifications for pipe required a hydrostatic test pressure of 60 per cent of the specified yield strength; however, it is permissible to test to 80 per cent of the material in the finished pipe. At the November 1943 meeting of the A.P.I. action was taken, which has not yet been ratified, for a constructive revision to permit a hydrostatic mill test pressure of 90 per cent of the minimum yield strength. Unless this is specified, the 60 per cent test will be made. Specifications should require the manufacturer, at the option of the purchaser, to test full joint specimens of pipe selected by the purchaser at random.

Specifications should include provisions for valves for manual and automatic operation as well as river, meter and manifold headers in the larger o.d. sizes. Shop fabrication and testing of headers are desirable.

Failure of concerted action on specifications by pipe users has resulted in the manufacture of pipe of outmoded quality and wall thickness far in excess of needs of natural-gas transmission.

Equipment Progress

Hycar Chemical Tints Its Synthetic Rubber

To assist its customers in distinguishing different grades of crude synthetic rubber, Hycar Chemical Co. of Akron has added a pale but distinct blue color to one of its crude rubbers, Hycar OR-25.

Hycar OR-15 is required for extreme oil resistance and particularly for resistance to aromatic fuels. Hycar OR-25, on the other hand, is not quite so oil-resistant, but must be used where low-temperature flexibility is of prime importance.

Byron Jackson Transfers Pugh

D. O. Pugh, sales and service engineer for the Oil Tool Division of Byron Jackson Co., has transferred his headquarters to Tulsa. He will make regular trips to cover the Kansas, Oklahoma and North Central Texas areas.

Lufkin to Build Cooper-Bessemer Oil-Field Engines

Lufkin Foundry & Machine Co., Lufkin, Tex., manufacturers of oil-field pumping equipment, by arrangement with Cooper-Bessemer Corp., will manufacture completely and sell two of the oil-field size Cooper-Bessemer engines. These are the GSC 5½ x 7, two-cylinder, two-cycle, 25 to 35 hp., and the GSD 7½ x 9, two-cylinder, two-cycle, vertical engine. These engines are of the medium speed class, running from 300 to 600 r.p.m. which are conservative rates established for oil-field engines for a long period of time.

Huizinga Advanced by National Supply Co.

Albert T. Huizinga has been elected vice president and treasurer of National Supply Co., Pittsburgh. Huizinga joined the company as treasurer, July 19, 1943, coming from Montgomery, Ward & Co., Chicago, where he had been assistant treasurer.

Attend Award Ceremony

J. M. Cullens, president, and C. E. Wright, sales manager, of Buda Engine Sales & Service Co., Inc., Tulsa, local distributor for Buda engines, attended the ceremonies attendant to the awarding of the Army-Navy "E" to the Buda company, April 27, at Harvey, Ill.

Two-in-One Valve

Designed for either a high-pressure drop and small volume or a low-pressure drop and large volume, a dual purpose, Type 608 butterfly valve (patent applied for) operates beyond the limitations of a single valve. Close control and shutoff of volume and pressure can be obtained and the valve is easily adapted to power operation.

The larger beveled vane seats against the body of the valve, while the smaller vane is free revolving. Four to six revolutions of the hand wheel completely open or close either valve vane. This type valve is available in various combinations of sizes and for operating pressures of 15 to 900 lb. per sq. in. It was developed by R-S Products Corp., Wayne Junction, Philadelphia 44.

Ed Koberg Now With BJ

The Oil Tool Division of Byron Jackson Co. announces the appointment of E. R. (Ed) Koberg as BJ Oil Tool service engineer at Baton Rouge, La., to cover Louisiana, Mississippi, Arkansas and the eastern Gulf Coast fields.

Trade Literature

Lane-Wells Co., 5610 S. Soto St., Los Angeles, Calif.—A 52-page bulletin, entitled "Lane-Wells Radioactivity Well Logging."

Aireotool Manufacturing Co., Dept. O.G., Springfield, Ohio.—Bulletin 21, for engineers interested in becoming acquainted with the application and operation of tube expanders in the processes of tube rolling and expansion.

Taylor Instrument Companies, Rochester, N. Y.—Bulletin 98159, descriptive of the Fulscope pneumatic set controller.

Twin Disc Clutch Co., Hydraulic Division, Rockford, Ill. — A 16-page booklet (Bulletin 135) entitled "Hydraulic Torque Converters."

Dresser Manufacturing Co., Bradford, Pa.—Folder reintroducing the company's Style 85 Bellmaster joint for cast-iron pipe.

Century Electric Co., 1806 Pine St., St. Louis 3, Mo.—A 12-page brochure on the company's line of direct-current motors.

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.—A new 44-page Bulletin B6249, describing the company's complete line of fractional horsepower Texrope V-belts and sheaves.

General Detroit Corp., 2200 East Jefferson Ave., Detroit 7, Mich.—A Buyers' Encyclopedia featuring more than 500 separate items in the industrial maintenance, safety and fire-protection fields.

Broderick & Bascom Rope Co., 4203 N. Union Blvd., St. Louis 15, Mo. — A new pocket-size edition of their "Riggers' Hand Book."

Cardox Corp., 307 N. Michigan Ave., Chicago, Ill.—A four-page bulletin which explains the engineering, performance and outstanding features of Cardox fire-extinguishing systems.

American Manganese Steel Division, American Brake Shoe Co., Chicago Heights, Ill. — Bulletin 244-P, entitled "Manganese Steel for Oil-Field Service."

% Proportioneers, Inc. %, Providence, R. I.—Bulletin 1100, which is a practical handbook of proportional feeding showing specific applications of the company's equipment in many fields.

Wailes Dove-Hermiston Corp., Westfield, N. J. — Two four-page folders, entitled "Bitumastic Blocks," and "Bitumastic Visual Index."

New Company Opens Office in New York

Offices have been opened at 420 Lexington Avenue, New York, by the newly formed General American Process Equipment Division of General American Transportation Corp. of Chicago.

Among the members of this new organization are H. M. Hunter, formerly vice president and manager of sales; P. B. Sadler, chemical engineer, and G. D. Dickey, manager of the filter department, of Goslin-Birmingham Mfg. Co., Inc., Birmingham, Ala.

These three recently organized Conkey Co. as successor to Conkey Filter Co. which itself was successor to Industrial Filtration Corp. and Moore Filter Co.

Companies comprising this new division also include Louisville Drying Machinery Co., Conkey Co., Turbo-Mixer Corp. and American Machine Co.

Reid Named Timken Production Manager

James F. Reid, former deputy chief of the Alloy Steel Branch of War Production Board, has been appointed production manager of Timken Roller Bearing Co. of Canton, Ohio. Reid had been production manager of the Steel and Tube Division of Timken before obtaining a leave of absence in 1942 to join WPB as chief of the Alloy Steel Section.

Reid first joined Timken 25 years ago as an employe in the production department, becoming, 10 years later, production manager of the Steel and Tube Division.

Sears Post Engineer With Army at Dallas

Maj. H. O. Sears, who was a member of the firm of Alliger & Sears, Houston, manufacturers' agents, before taking a commission in the Army, is now serving as post engineer in charge of property belonging to the 8th Service Command in the city of Dallas. He attended the Oil and Gas Power Conference of the American Society of Mechanical Engineers at Tulsa when methods improving diesel engine operation were featured, including those for the centrifugation of lubricating and fuel oils with the development of which he was actively concerned in civil life.

Johnson Appointed Hendy General Sales Manager

Wallace Johnson was recently appointed general sales manager of Joshua Hendy Iron Works at Sunnyvale, Calif.

Johnson joined the Hendy organization in 1942. His work has included several months at the Crocker-Wheeler Division at Ampere, N. J., in the capacity of assistant to the president; several months as an administrative head at Sunnyvale; and since June 1943 until his current appointment, he has been assistant general manager of the Pomona Pump Division at Pomona, Calif.

Morris Levit is head of sales for the Joshua Hendy division, with C. L. Barrett as sales manager at Pomona division and L. T. Warner at Crocker-Wheeler division.

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HELP WANTED

WANTED: Sales Engineer experienced in designing, improving and selling Unit Pumpers. State age, experience, salary, etc. Reply Box C-320, The Oil and Gas Journal, Tulsa, Okla.

WANTED: Electrical-Instrument man for general refinery maintenance work in Central Michigan area. Steady work with earnings about $250 to $260 per month. Release required. In reply detail previous experience, references and draft status. Box C-311, The Oil and Gas Journal, Tulsa, Okla.

CHEMICAL ENGINEERS with experience in any of the following petroleum refining operations (1) light ends recovery equipment, absorbers, stabilizers, etc. (2) catalytic cracking equipment or (3) crude distillation equipment and similar processing units. State in detail educational background, positions held with detailed explanation of work handled, age, and number dependents, also draft status. Foster Wheeler Corporation, Petroleum Refinery Division, 165 Broadway, New York 6, N. Y.

WANTED: A Petroleum Engineer with field experience for engineering development work, with a large manufacturer of oil field equipment and materials. Permanent position with good future for right man. In replying state age, education, business background, salary desired, etc. Box C-250, The Oil and Gas Journal, Tulsa, Okla

WANTED

MAN with engineering background having thorough knowledge of modern high and low pressure gas distribution practice, cleaning, dehydration, sizing of equipment, plant layout. Permanent position with large manufacturer. Write giving full transcript of experience. Box C-301, The Oil and Gas Journal, Tulsa, Okla.

EMPLOYMENT OPPORTUNITIES FOR FOREIGN SERVICE

The Arabian American Oil is interested in receiving applications from technically educated men, and/or men with oil field experience, for work in Saudi Arabia. This offers a splendid opportunity for advancement and postwar security, with good working conditions, hospital and medical care, liberal benefit plans, and vacation privileges in the United States.

Write or apply to our Relations Department

ARABIAN AMERICAN OIL CO.
200 Bush Street
San Francisco 4, California

HELP WANTED

MECHANICAL DRAFTSMAN WANTED: To redesign, improve, and supervise a line of drilling rigs and production equipment. State experience, age, salary, etc. Reply Box C-273, The Oil and Gas Journal, Tulsa, Okla.

MEN with geological, geophysical, or engineering training or experience, wanted for work with large oil company, Rocky Mountain area. Box C-315, The Oil and Gas Journal, Tulsa, Okla.

COMPETENT, energetic and thoroughly experienced superintendent for modern refinery producing aviation gasoline and other refinery products. Located very close to city with good climate and attractive homes. Good salary with fine opportunities for right man. Replies held confidential. Address Box C-319, The Oil and Gas Journal, Tulsa, Okla.

CAPABLE control men and stillmen for cracking plant making aviation gasoline. Good salary. Desirable location. Give references and experience. Address P.O. Box 1871. Tulsa, Oklahoma.

WANTED: Plane-table engineer, experienced. Must have Certificate of Availability. Would prefer to interview at Tulsa or Oklahoma City. LAUGHLIN-SIMMONS & CO., 615 Oklahoma Natural Gas Bldg., Tulsa, Okla.; 710 Braniff Bldg., Oklahoma City, Okla.

A LEADING Oklahoma manufacturer of oil field equipment wishes to employ a man capable of handling work analysis and routing, time studies, and similar duties in the manufacturing section. Address M. G. McCool, American Iron & Machine Works Company, Oklahoma City, Oklahoma.

ENGINEER qualified for license capable of designing municipal plants including Gas. Experience in selling himself desirable. Good opportunity for right man to establish permanent private practice in South. Box C-323, The Oil and Gas Journal, Tulsa, Okla.

SAFETY AND CORROSION ENGINEER. Mechanical engineer and metallurgist, to supervise safety and corrosion at Mid-western Refinery. State in detail educational background, experience, age, draft status, salary desired. Reply to Box C-400, The Oil and Gas Journal, Tulsa, Okla.

WANTED: Mechanical Draftsman with experience in designing pumping units, jacks, etc. State age, experience, salary, etc. Reply Box C-321, The Oil and Gas Journal, Tulsa, Okla.

MANUFACTURER'S sales representative wanted for staple pumping equipment through stores only, exclusive territory, commission basis. May be handled with other lines. Name desired territory. Box C-404, The Oil and Gas Journal, Tulsa, Okla.

SITUATIONS WANTED

POSITION with Company having opening in operating department. 15 years continuous service in large refinery as operator supervisor in cracking department. Box C-317, The Oil and Gas Journal, Tulsa, Okla.

SUPERVISOR with 16 years practical experience oil and gas production, gasoline plant, gas measurement, office management, purchasing. Available now. Box C-322, The Oil and Gas Journal, Tulsa, Okla.

STOREKEEPER, 15 years' refinery experience, desires 48-hour work week on present basic rate. Must have postwar future. Can comply with WMPC. Box C-305, The Oil and Gas Journal, Tulsa, Okla.

CIVIL ENGINEER-CONSTRUCTION SUPERINTENDENT, thirty years Engineering and Construction experience. Twenty years in responsible charge all types construction-municipal, highway, structural, refineries, pipe lines. Good organizer, executive and administrative ability. Age 48. Excellent physical condition. Salary commensurate with responsibilities. Available immediately. Box C-316, The Oil and Gas Journal, Tulsa, Okla.

GRADUATE petroleum engineer, with fifteen years experience, draft exempt. Can furnish A-1 references. Will consider engineering or sales engineering work. Box C-283, The Oil and Gas Journal, Tulsa, Okla.

SITUATIONS WANTED

PRODUCTION Superintendent, graduate engineer, 47, draft exempt, with ten years successful experience with all phases of handling deep pumping wells, whose work has included safety supervision and instruction, desires Mid-Continent connection where this training and experience can be fully utilized. Excellent health, now available. Box C-313, The Oil and Gas Journal, Tulsa, Okla.

CHEMICAL Engineer with Ph.D. Degree, age 40, Draft 3A-H, married, 15 years' Petroleum Refining experience, supervising plant operation, charge of research and development, construction of 100 Octane Gasoline Refinery. Especially interested in Petroleum Research and development or refining. Would consider responsible position in related industries. Prefer California or East Coast. Have availability certificate. Box C-304, The Oil and Gas Journal. Tulsa, Okla.

ELECTRICIAN with 8 years construction, 8 years with one oil company, and 2 years supervisory experience. Capable of assuming the responsibilities of construction and/or maintenance of generating and distribution equipment. Foreign connection considered. Box C-314, The Oil and Gas Journal, Tulsa, Okla.

DRILLING and Production Superintendent or tool pusher, 15 years' experience, desires connection with growing company in shallow area. Can furnish shallow drilling equipment for interest. Will take interest and living wage. References exchanged. P.O. Box 55, Hugoton, Kansas.

FOR SALE — MAPS

MISSISSIPPI-ALABAMA BASE MAP. Scale 8 miles to inch. Size 4½ ft. square. Includes Florida Panhandle and eastern Louisiana. Shows County names, County Seats, all oil development, depths dry holes, who drilled them, names of fields, many prospects. Also 16 major anticlines and faults and principal surface geologic contacts in both States from authentic sources. Price $15 paper, $20 linen. Individual field maps on all 7 Mississippi fields showing everything, $3.50 each. Also complete coverage County and Parish maps in South Texas and South Louisiana, many County maps in Mississippi. All fields above area numbering 723 now mapped, $3.50 each.

ZINGERY MAP COMPANY
Houston 2, Texas

EQUIPMENT WANTED

WANTED TO BUY

2000 to 3000 feet of 2-inch upset seamless tubing in 20 or 30-foot lengths with tool joints not larger than 3⅜-in. O.D., suitable for use as drill pipe on Failing core drill. Merry Bros. & Perini, Box 840, Abilene, Texas.

MAGNETOMETER WANTED

An Askania vertical component magnetometer, preferably with a temperature compensated magnetic system. The Mining Corporation of Canada, Limited, 350 Bay St., Toronto 1, Canada.

WANTED TO BUY: Two new style Askania Magnetometers. Address: Sidney A. Stubbs Oil Properties, 119 East Park Avenue. Tallahassee, Florida.

WANTED

Unlimited quantity of
Structural Steel — Pipe — Tubing
Casings and Valves, all sizes

SONKEN-GALAMBA CORP.
Kansas City (18), Kansas

WANTED TO BUY

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